Jacobs

Task 4: Final Report

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DPW 724 / K23-196

Hydrologic and Hydraulic Drainage Study - Lakeview N&S
March 31, 2025

Task 4: Final Report

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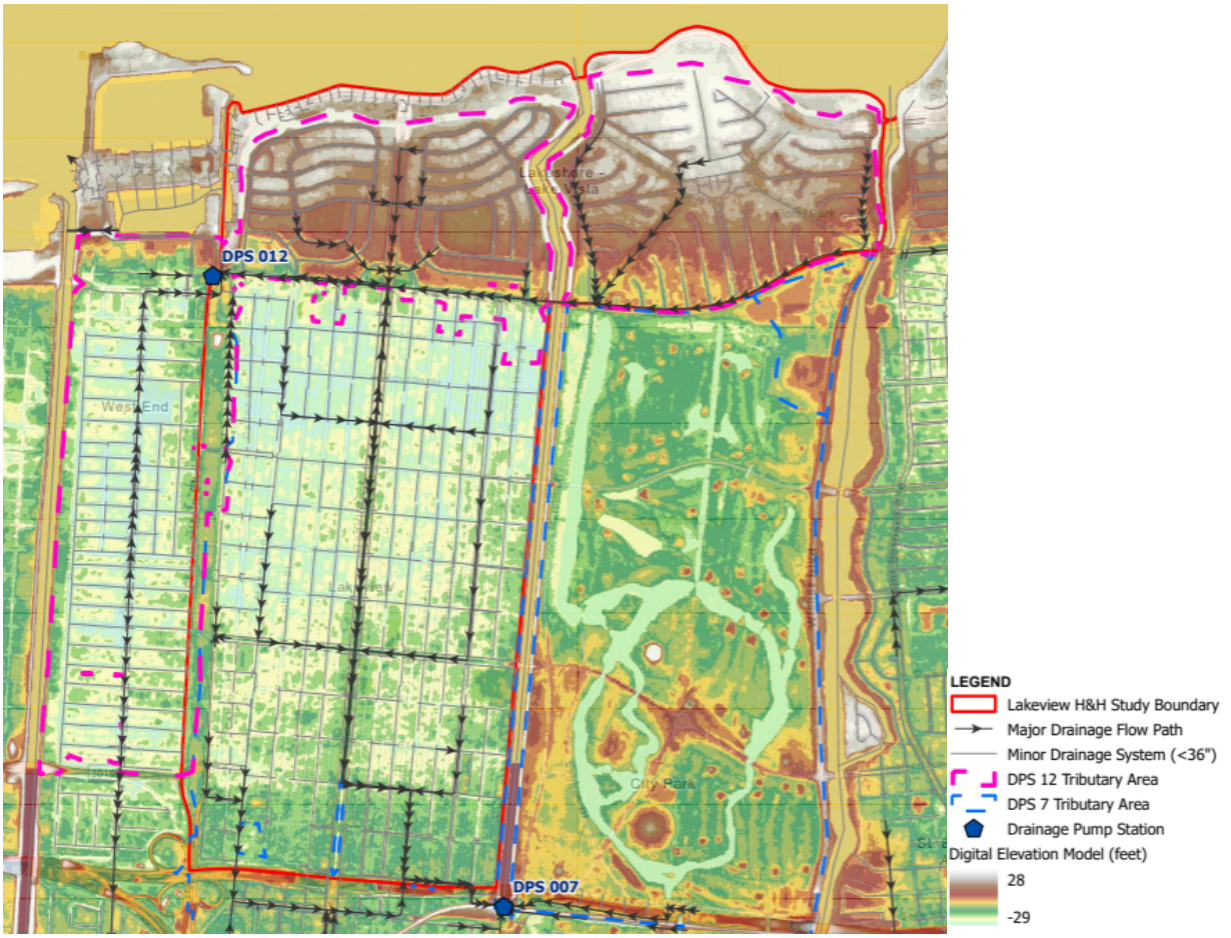
Executive Summary

Introduction

The City of New Orleans (CNO) has long faced significant drainage challenges, particularly in the Lakeview area, due to its low elevation and drainage system issues, shown in Figure ES-1. In September 2023, the City of New Orleans (CNO) Office of Resilience and Sustainability selected Jacobs Engineering Group, Inc and its teaming partners to conduct a hydrologic and hydraulic (H&H) drainage study of the Lakeview, Lake Vista, and Lake Shore neighborhoods of New Orleans. This area was chosen due to its history of flooding, as observed by both residents and city officials. Recent storm events in September 2023 and April 2024 resulted in standing water depths of several feet and prolonged inundation, underscoring the need for a drainage solution study. The scope of study was included in main tasks: data collection and analysis (Task 1 TM found in Appendix A), existing conditions model update (Task 2 TM found in Appendix B), and project scoping and analysis (Task 3 presented in this Final Report) Project scoping and evaluation included modeling proposed flood-reducing concepts, 10% design documents and cost estimates, and feasibility level blue and green stormwater infrastructure (BGSI) recommendations to reduce flooding in these neighborhoods.

Figure ES-1. Overview of Drainage System Flow Paths



Assessment of Existing System Drainage

The assessment of the existing drainage system in Lakeview revealed several critical issues. The primary causes of flooding are deficiencies in both major and minor drainage conveyance features, pumping capacity limitations at the system outfalls (DPS 07 and DPS 12), and a lack of surface and subsurface storage. These issues are exacerbated by urbanization, non-stationary climate conditions, and the area's low-lying topography. A sensitivity analysis showed that limited pumping capacity leads to backwater effects, particularly in the double barrel beneath Canal Blvd., causing water levels to rise in the northern part of Lakeview. Implementing a Free Outfall scenario, which represents unlimited pumping capacity, significantly reduced flood extents and depths, highlighting the need for systemic network and pump capacity improvements. The study emphasized the importance of addressing these systemic issues to improve the overall drainage and resilience of the Lakeview area.

Project Opportunities

While improving DPS capacity and reviewing the conveyance system were beyond the study's scope, the focus was on addressing the lack of storage through blue-green stormwater infrastructure (BGSI) and conveyance improvements. BGSI opportunities were identified through creating a BGSI toolbox, developing site typologies, GIS analysis, and overlaying hot spots from existing conditions modeling. The BGSI toolbox includes practices like wet ponds, dry detention basins, underground detention, bioretention areas, and permeable pavements, which provide benefits such as flood reduction, water quality improvement, and urban heat island mitigation. Site typologies considered for BGSI implementation included ROW strips, neutral grounds, parking areas, schools, parks, residential, and commercial properties. Feasibility constraints like proximity to trees, elevation, soil properties, and slope were considered when identifying project opportunities. Ultimately, 12 project concepts were selected for further development, modeling, and scoring, focusing on areas with the greatest flood depths and opportunities for strategic storage solutions. These projects aim to reduce flooding while enhancing community resilience and urban aesthetics.

Concept Modeling and Analysis

The hydraulic benefits of the concepts described in Section 4 were evaluated using the updated and validated existing conditions PCSWMM model for the 10-year, 24-hour design storm. Detailed development of the concepts included connectivity to existing drainage infrastructure, storage volumes, and inlet and outlet controls. Each concept was modeled individually to assess hydraulic benefits, and a combined suite of concepts was modeled to understand collective benefits. Various boundary conditions, including the current pump system and a "free outfall" scenario representing future capacity upgrades, were considered to understand how the interconnected system of pipes, pumps, and BGSI measures influence flooding. A quantitative evaluation of the modeling results was conducted based on flood metrics such as maximum and average flood depth reduction, area of flood reduction, flood volume reduction, and hot spot flood depth reduction. The results indicated significant hydraulic benefits, with detailed flood maps and metrics provided in Appendix F. The study emphasized the need for comprehensive network and pump capacity improvements to achieve meaningful flood reductions.

Results Analysis

The analysis of the modeling results for the 12 individual concepts and a combined model "Concept 13" provided valuable insights into their flood mitigation effectiveness:

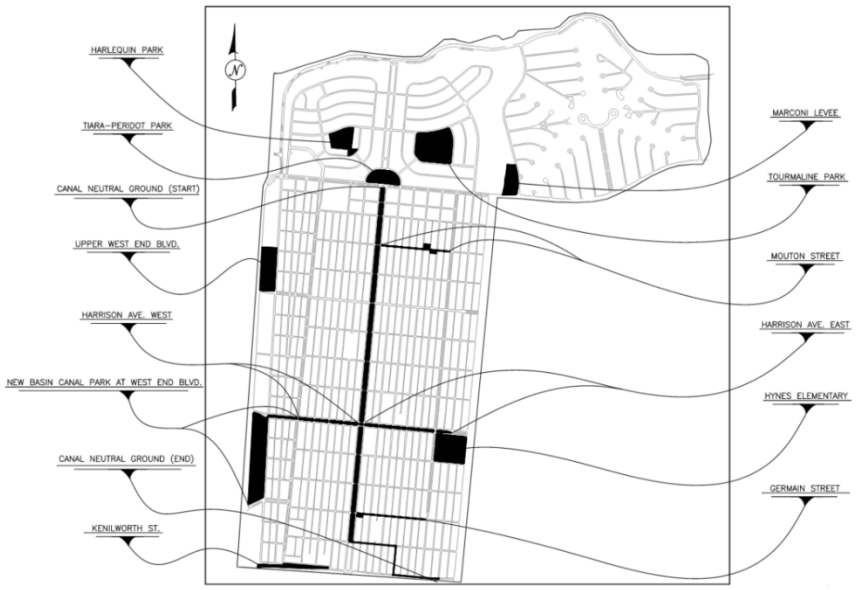
- Concept 12 (Kenilworth Street) showed the highest maximum reduction in flood depth at 1.5 feet, indicating its effectiveness in storing flow during peak events.

- Concept 4 (Marconi Levee) also demonstrated significant reduction at 1.1 feet. Most concepts achieved an average reduction of 0.1 to 0.2 feet across the study area.
- Concept 11 (New Basin Canal) stood out with a significant area of flood reduction (37.5 acres) and flood volume storage capacity (4.9 MGAL).
- Concept 7 (Harrison Avenue) was notable for its flood volume reduction of 2.7 MGAL. Hot spot analysis revealed that Concept 4 was most effective in Lake Vista, while Concept 11 was most effective in NW Lakeview.
- Combined modeling of all concepts reduced flooding by over 1 inch across 410 acres and reduced water volume by over 14 MGAL. The combined concept showed the highest performance across all flood metrics, but additional improvements in conveyance, storage, and GSI are needed to fully mitigate a 10-year flood event.

Concept Development

The Jacobs team identified 12 locations for BGSI opportunities, shown on Figure ES-2. Cost estimates, future design considerations, and operations and maintenance considerations were developed for each of these concepts.

Figure ES-2. Concept Locations



Concept Scoring

To score the twelve proposed concepts, six scoring criteria were developed to evaluate their holistic benefits. These criteria included annual operations and maintenance (O&M) costs, hydraulic benefits, infrastructure connectivity, enhancement of community amenities and equity, proximity to partnership opportunities, and cooling potential. Each project was scored on a scale of 1 to 5 for each criterion, with higher scores indicating greater benefits. The criteria were weighted based on their importance to the City of New Orleans, and the cumulative weighted benefit scores were compared to project costs to prioritize projects based on maximizing overall benefits relative to costs. The final scoring is summarized in the Flood Metric and Cost Summary shown in Table ES-1 and shown as weighted benefit versus cost to determine cost efficiency in Figure ES-3.

Figure ES-3. Weighted Benefit vs. Cost Graph

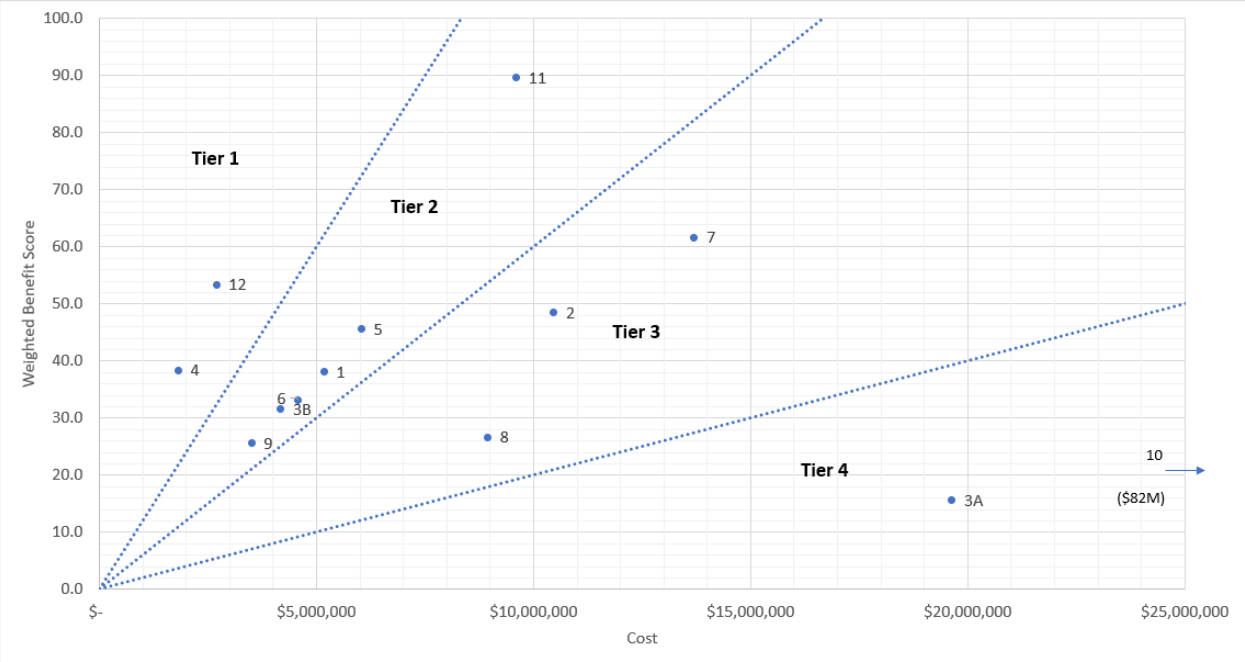


Table ES-1. Flood Metric and Cost Summary

ID	Project	Flood Volume Reduced (MGAL)	Area of Flood Reduction > 1 in (acres)	Average WSE Flood Reduction (in.)	Total Cost	Weighted Benefit Score
1	Harlequin Park	1.9	6.4	-2	$5,170,000	38.1
2	Tourmaline Park	2.3	1.2	-2	$10,460,000	48.5
3A	Tiara and Peridot Park	0.2	1	-3	$19,630,000	15.6
3B	Tiara and Peridot Park	1.1	0.6	-2	$4,170,000	31.6
4	Marconi Levee	1.6	14.1	-2	$1,810,000	38.4
5	Upper West End	2	0.7	-2	$6,030,000	45.6
6	Mouton Street	1	0.3	-2	$4,560,000	33.2
7	Harrison Ave	2.7	2.2	-2	$13,700,000	61.7
8	Hynes Elementary School	0.8	0.2	-2	$8,940,000	26.7
9	Germain Street	0.7	0	-2	$3,500,000	25.7
10	Canal Blvd	0.4	24.5	-1	$82,310,000	20.5
11	New Basin Canal	4.9	37.5	-1	$9,600,000	89.7
12	Kenilworth Street	2.2	5.8	-4	$2,690,000	53.4

Summary and Recommendations

This study has identified BGSI concepts that can help manage flooding in the Lakeview study area. However, a combination of BGSI and gray infrastructure investments is necessary to significantly reduce flooding and risk. The recommendations emphasize phased implementation to maximize immediate benefits, overall cost-effectiveness, and synergy with other neighborhood investments.

- **Prioritize Tier 1 High-impact Concepts:** Focus on Concepts 4 (Marconi Levee) and 12 (Kenilworth Street) due to their significant hydraulic benefits and cost efficiency. These projects are less influenced by downstream backwater conditions and utilize underutilized open spaces.
- **Prioritize Tier 2 Investments:** Concepts 1, 3B, 5,6, 9, and 11 should be prioritized to complement gray infrastructure improvements and address areas with the highest flooding. These projects will be more effective when paired with DPS improvements.
- **Opportunistically Pursue Tier 3 Concepts:** Concepts 2, 7, and 8 are effective but have a lower benefit-to-cost ratio. Combining these with other city projects can reduce costs and maximize benefits.
- **Optimize or Defer Inefficient Tier 4 Concepts:** Concepts 3A (Tiara Park, inline) and 10 (Canal) are not cost-effective in their current configurations. Further modeling may identify more efficient solutions.
- **Address Persistent Surcharging:** Implement conveyance improvements to address surcharging unrelated to pump capacity limitations, providing additional relief to hot spot areas.
- **Enhance Storage and Conveyance:** Integrate BGSI with conveyance improvements to enhance storage and reduce flood risk.
- **Conduct Further Investigations:** Investigate the stormwater collection system's capacity and necessary DPS upgrades to address backwater conditions and increase flood depth reductions.

By prioritizing high-impact projects and addressing key issues, these recommendations aim to optimize flood mitigation efforts through a combination of structural and green infrastructure approaches, positively impacting the community.

Preliminary Phasing Recommendations

The hydraulic analysis reveals complex system capacity challenges in the Lakeview area, including local conveyance deficiencies, urbanization impacts, and lack of storage. Most concepts will have limited impact until combined with other concepts and/or DPS improvements. During project phasing, opportunities for co-development with other city departments should be considered to reduce costs, minimize public impacts, and maximize benefits.

- **Germain Street (Concept 9) and Mouton Street (Concept 6):** Improve conveyance to Canal Boulevard and provide flow control. Consider reliance on DPS upgrades.
- **Canal Boulevard (Concept 10) and Harrison Avenue (Concept 7):** May require phased implementation due to scale. Conduct full schematic design concurrently, with construction phased from downstream to upstream. Concept 10 is generally not recommended due to cost and hydraulic benefit.
- **New Basin Canal Park (Concept 11) and Harrison Avenue (Concept 7):** Highly interconnected; should undergo concurrent schematic-level design.
- **Harlequin Park (Concept 1) and Tourmaline Park (Concept 2):** Likely require less coordination with other projects.
- **Marconi Levee (Concept 4):** Hydraulically independent and may be phased independently.

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1. Introduction

1.1 Study Background

In September 2023, the City of New Orleans (CNO) Office of Resilience and Sustainability (ORS) selected Jacobs Engineering Group, Inc. (Jacobs) to conduct a hydrologic and hydraulic (H&H) drainage study for the Lakeview area (Lakeview N&S). CNO identified this area for study because of the long history of flooding as observed by both Lakeview residents and City officials. Historically, New Orleans has faced significant drainage challenges, with the Lakeview area being particularly vulnerable due to low elevation.

Two recent storm events, one occurring in September 2023 (Labor Day event) and one occurring in April 2024, produced standing water depths of several feet and prolonged inundation. These events highlighted the need for a drainage solution study. The City selected Lakeview for this study not only due to its history of flooding but also as a benchmark for the potential success of H&H drainage studies in developing and expanding green infrastructure opportunities throughout the city.

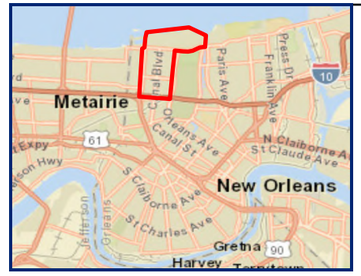
Concurrent with Lakeview N&S H&H Study conducted by Jacobs, the City tasked CDM Smith and Digital Engineering to conduct similar studies for the areas of Mid-City / Navarre and West End, respectively. During the execution of these studies, there was significant collaboration between the three consultants to develop a consistent methodology for the H&H modeling and project concept development. Specific objectives of the three studies were to develop a better understanding of the complex drainage system, update previously developed models, and identify a suite of 10 to 12 projects that can be leveraged into funding acquisition, future design, and eventual construction.

The flooding challenges in Lakeview are multi-faceted and depend on the complex interaction of surface and subsurface storage, conveyance, and pumping capacity. This study focuses on developing a suite of projects that are part of a drainage solution which must ultimately include upgrades to and capacity improvements for both drainage pump stations (DPS) and the collection system. The specific projects associated with DPS upgrades and conveyance improvements are beyond the scope of the current study; however, the work documented herein does provide information that will focus these future efforts.

1.2 Study Area

The Lakeview North and South (N&S) Study Area encompasses the Lakeview, Lake Shore, and Lake Vista neighborhoods located in northwestern New Orleans as shown in Figure 1-1. The area is bordered by Lake Pontchartrain to the north, 17th Street Canal to the west, City Park to the east, and Interstate I-610 to the south. The Mid-City / Navarre study area is directly south of Lakeview N&S and West End directly west.

The Lakeview area is served by two major DPS, DPS-12 and DPS-07. Although the drainage system is entirely interconnected, DPS-12 generally serves the area of Lakeview north of Harrison Street whereas DPS-07 serves the area south of Harrison. DPS-07, which is much larger than DPS-012, serves additional areas extending into Mid-City. Major drainage components include those with diameter greater than or equal to 36 inches in diameter compared to minor features with diameter less than 36 inches. Components of the major drainage system that convey flow to the two DPS include large box culverts along Canal, West End, and Allen Toussaint Boulevard whereas minor drainage components discharge into these major features. The drainage infrastructure in the study area generally underperforms the City's current design criteria of a 10-year, 24-hour storm event. The overview of the Lakeview drainage system is shown in Figure 1-2.



LEGEND

Project Boundaries

- Lakeview H&H Study Bounds
- Mid City/Navarre/City Park H&H Study Bounds
- West End H&H Study Bounds
- Drainage Pump Station
- Lakeview Drainage System

N
W E
S

0 2.5 5 10 Miles

Figure 1-1
Project Area Overview

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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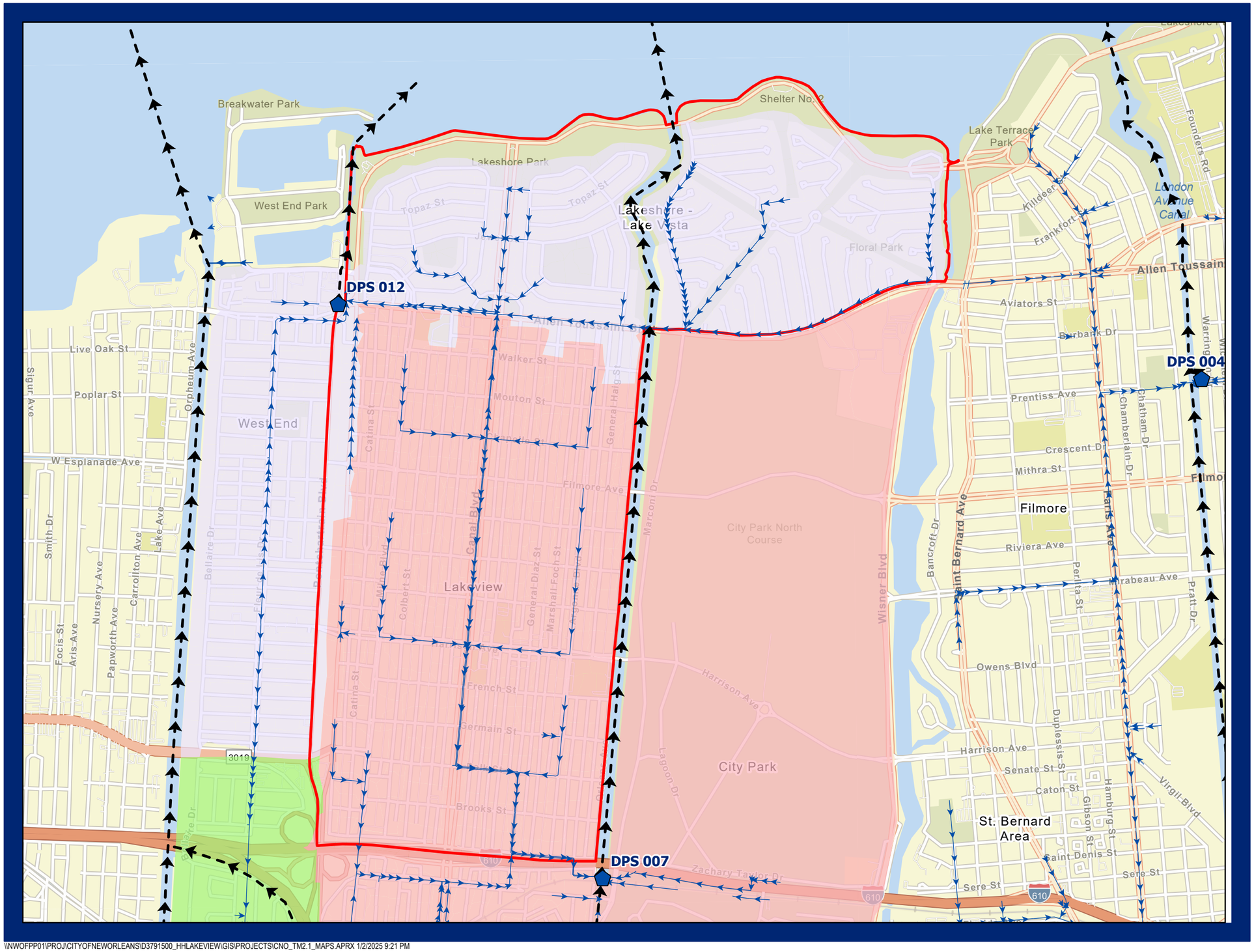

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- Lakeview H&H Study Boundary
- DPS 2 Basin
- DPS 7 Basin
- DPS 12 Basin
- Major Drainage Structures (>= 36")
- DPS Flow Direction
- Drainage Pump Station

N

0 0.13 0.25 0.5 Miles

Figure 1-2:
Overview of Drainage Paths
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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1.3 Study Overview

The study was divided into three main tasks: data collection and analysis (Task 1), existing conditions modeling (Task 2), and project development and analysis (Task 3). The efforts associated with Task 1, Data Collection and Analysis, were documented in a technical memorandum (TM) provided here as Appendix A. The TM includes a presentation and discussion of the following:

- **Data Collection** – Jacobs received and compiled existing information, including existing models managed by Ardurra, survey information, final design and/or as-built plans, and GIS data.
- **Data Gap Analysis** – Existing models were reviewed, and data gap analysis was conducted to determine future model improvements.
- **Drainage Infrastructure Survey and Preliminary Field Reconnaissance** – Batture Engineering, a Jacobs subconsultant, conducted a field survey of approximately 180 major drainage structures within the Lakeview N&S area.

Similarly, a TM was prepared for Task 2, Existing Conditions Modeling (see Appendix B) which documents the results of the following activities:

- **Model Calibration – Existing Conditions** – Jacobs reviewed the existing Personal Computer Storm Water Management Model (PCSWMM) models and determined that surface and pipe adjustments and pump updates were required.
- **Model Simulations** – Jacobs modeled a range of storm events under existing conditions and calculated flood metrics to identify hot spots to guide project development. Production runs were executed for the 1-, 10-, and 25-year 24-hour storms.

This final report summarizes the results and key takeaways of Task 1 (Jacobs, 2024a) and Task 2 (Jacobs, 2024b). The reader is referred to the appendices for a more detailed account of these activities. Building on these two TMs, Jacobs conducted additional activities to develop recommendations for drainage improvements consisting of blue and green stormwater infrastructure (BGSI) measures. Activities included:

- **Project Opportunity Development** – Project opportunities were identified, including distributed green stormwater infrastructure (GSI), conveyance improvements, and opportunities for regional projects based on available space (large areas within the CNO right-of-way [ROW], medians, city parks, or other properties owned or controlled by CNO). Project opportunities were guided by a hot spot analysis based on the existing conditions modeling results.
- **Concept Modeling** – Concepts were further developed from the identified project opportunities to include details of connectivity to the existing drainage infrastructure, storage volumes, and inlet and outlet control. These details were used to update the existing conditions model. Although numerous permutations and combinations of projects could be developed as alternatives, the project benefits were assessed first by modeling each project individually. A combined suite of projects was finally modeled to understand the collective benefits of the projects. Concept modeling also considered various boundary conditions including the current pump system as well as a scenario that represented future capacity upgrades, that is a "free outfall" scenario.
- **Concept Design** - The modeled projects underwent further design, including preparation of cost estimates to a 10% design level. Concept designs are included in Appendix E.
- **Concept Prioritization** – Concepts were scored based on various criteria, including weighted factors that reflected CNO's priorities. The scored projects underwent a benefit cost analysis to arrive at a list of prioritized projects. Recommendations for phasing and future design and maintenance considerations were also prepared.

2. Data Collection and Modeling Approach

An initial data collection task was undertaken to identify information that would serve as the basis of this study as well as identify gaps in available data. During this task, the existing H&H model for the Lakeview area was reviewed for the purpose of developing a modeling strategy and approach. This work is summarized below and more thoroughly documented in the TM1 included in Appendix A.

2.1 Data Sources

Jacobs used the following data sources in the development of this study:

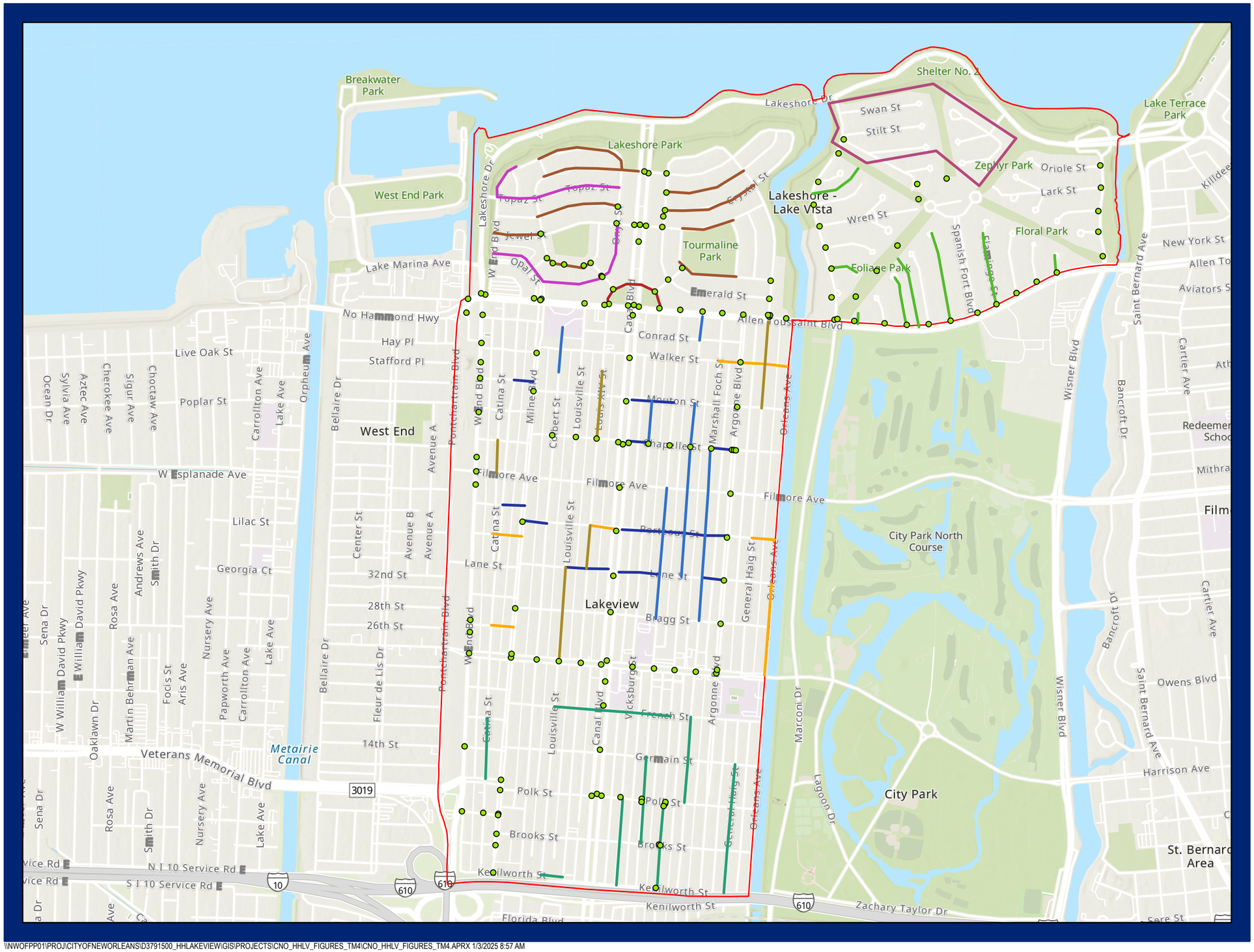
- PCSWMM model of CNO (previously managed and updated by Ardurra on behalf of the Sewerage and Water Board of New Orleans [SWBNO]) validated using high-water marks from May 8, 1995, storm event but not formally calibrated due to a lack of stage data
- Previous documentation and studies, including the *City of New Orleans Stormwater Management Capital Improvements Plan* (CDM Smith, 2012), *Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems* (BCG Engineering and Consulting, Inc., 2016), and the *Stormwater Master Plan Report* (prepared for SWBNO by Ardurra and ILSI Engineering, 2022)
- Existing surveys, with an updated survey conducted by Batture, LLC in March 2024, covering over 180 major drainage structures
- Drawings and as-builts from the Federal Emergency Management Agency's (FEMA) Recovery Roads program and CNO capital improvement programs within the Lakeview area
- Geospatial data from the CNO GIS Open data portal
- Rainfall data from the SWBNO supervisory control and data acquisition system at the DPS
- Data collected by ISeeChange, in coordination with the Water Collaborative, to gather real-time observations of climate events in the Lakeview area for validation purposes. Media and photos from September 4, 2023, and April 10, 2024 events were used to validated predicted flooding results.

2.2 Review of Existing Model and Proposed Model Updates

The H&H models for the CNO drainage system have evolved through various stages and software since the early 1980s, most recently using PCSWMM. Jacobs received the current PCSWMM model developed by Ardurra for SWBNO that covers the Lakeview area associated with DPS 07 and 12. A detailed review of this model was previously presented in TM 2, which references version 12 of the model (Version and Model Log found in Appendix I).

The key model elements recommended for completion in Task 2 (detailed in Section 3) and completed in version 17 of the model update contain the following:

- One-dimensional (1D) dual-drainage model with storage areas based on 2012 topography data to be converted into two-dimensional (2D) model using 2021 topography data, removing dual drainage and converting storage areas into 1D junctions.
- DPS 07 and DPS 12 pumps capacity to be updated based on operational data provided by SWBNO.
- Pipe network to be adjusted based on the survey data collected within this scope of work and road plans provided by CNO, shown in Figure 2-1.



LEGEND

- Batture Survey Points

DPW/SWBNO Project ID

- RR076
- RR079
- RR082
- RR084
- RR086
- RR087
- RR091
- RR220
- RR221
- RR222

0 0.1 0.2 0.3 Miles

N

Figure 2-1:
Model Network Updates
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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3. Existing Condition Modeling

This report builds upon the information presented in TM 2 (Appendix B), which provides a detailed description of work completed in Task 2 Existing Conditions Modeling. Section 3.1 summarizes the key updates made to the PCSWMM model, including surface updates, infrastructure data integration, DPS review, model optimization, and boundary condition establishment. Sections 3.2 and 3.3 discuss the testing and calibration of the model.

Additional modeling was conducted after Task 2 to better understand the system and guide the development of potential projects to alleviate flooding. Specifically, Sections 3.4 and 3.5 present the results of the existing condition modeling and sensitivity analysis, respectively, conducted to develop an assessment of the existing drainage system.

3.1 Model Updates

Jacobs reviewed the existing model setup and calibration data sets and identified potential data gaps and model deficiencies, as documented in TM1. The methodology for model adjustments was discussed in depth in TM2 (Jacobs, 2024b) (Appendix B). This section contains a brief overview of the conveyance system, surface, and pump model adjustments.

As in the existing model, subcatchment parameters remained unchanged, and subcatchments were connected to 1D junctions. The conveyance system was updated using the survey conducted by Jacobs' subconsultant, Batture Engineering, plans from the FEMA Recovery Roads program, and CNO capital improvement programs within the Lakeview area. Batture Engineering conducted a survey of major drainage structures (pipes greater than or equal to 36 inches in diameter) within the Lakeview study area. Field surveys were conducted for 189 manholes. Figures and tables containing survey project limits are provided in Appendix B (Jacobs, 2024b). Based on the infrastructure survey, approximately 78% of manholes have an updated invert elevation that is lower than the corresponding measurement in the Ardurra model. The average difference between the updated invert elevations and the Ardurra invert elevations is approximately -0.74 feet. The shapes and dimensions of the pipes were also updated.

The existing 1D model was updated within the area to develop a 2D model. The overall model still contains adjacent drainage areas outside of the Lakeview study area that are simplified 1D storage areas with conduits representing the interconnectivity of the system across specific drainage basins or DPS service areas. Instead of using stage-storage curves, the 1D and 2D Lakeview models represent surface storage within the Lakeview area with a 2D mesh. This conversion eliminated uncertainties associated with stage-storage curves and allowed for better management of the large volumes of overland flow observed during recent flooding events. Table 3-1 shows an overview of the surface model parameters adjusted.

Table 3-1. Model Parameters

Parameter	Details	Value
Surface – Roads	2D rectangular mesh	35-foot resolution
Surface – Remaining Model Domain	2D rectangular mesh	70-foot resolution
Land Use – Roads	Manning's roughness	0.015
Land Use – Buildings	Manning's roughness	0.1
Land Use – Green Space	Manning's roughness	0.05
Catch Basin	Six per junction	24-foot cumulative width by 0.75-foot height

The Lakeview study area includes DPS 07 and DPS 12. The DPS 07 drainage basin includes a major part of Lakeview and City Park and the northern half of Mid-City. DPS 07 is directly downstream of DPS 02, which includes the southern half of Mid-City Basin, Tremé, and Downtown, and discharges into the Orleans Canal, which in turn discharges into Lake Pontchartrain. DPS 12 includes the northeastern part of Lakeview, City Park, and the West End. DPS 12 discharges directly into Lake Pontchartrain. The total capacities of the DPS were collected from the nameplate information at each DPS, suction level, state data (i.e., on or off), and peak power data for the storm events as discussed in Appendix B (Jacobs, 2024b).

Boundary conditions define the external conditions or inputs that affect model simulations. These conditions set the limits or constraints under which the model operates and can significantly influence the behavior and outcomes of the simulation. The boundary conditions were compared with neighboring study areas at outfalls. Jacobs, Digital Engineering Inc (DEI), and CDM Smith (CDM) exchanged hydrographs for review. CDM provided hydrographs for Mid-City, DEI supplied hydrographs for West End, and Jacobs provided hydrographs for the Lakeview study areas for a 10-year, 24-hour storm event for review. Given Lakeview's location between Mid-City and West End, flow data were provided to each consultant for comparative analysis and review. The flow data were integrated into both the Mid-City and West End models.

3.2 Model Testing and Calibration

After updating the model, Jacobs conducted calibration and validation using available data using model version v12. Model validation compares model results (e.g., flood depths, inundations, and durations) with real-world observations to provide accuracy. The existing conditions model was validated using past storm events, specifically those on September 4, 2023, and April 10, 2024 (Appendix B).

Calibration involved both qualitative and quantitative methods in which model results were compared to observed conditions. Qualitative comparisons focused on matching inundation depth and extent with previous flooding observations, whereas quantitative comparisons used observed water mark (OWM) depths and suction level heights at the DPS from the storms on September 4, 2023, and April 10, 2024.

Rainfall data for validation came from SWBNO for DPS 07 and DPS 12 locations. Errors were noted during heavy rainfall, with inconsistent timesteps ranging from 1 second to nearly 1 hour. Adjustments were made to evenly distribute the total rainfall over 15-minute intervals. The April 2024 event from DPS 07 was chosen for its higher total rainfall (6.5 inches in 8 hours), representing a 5- to 10-year recurrence interval for a 12-hour duration according to NOAA Atlas 14 Depth Duration Frequency (DDF) curves. The September 2023 event also used DPS 07 data, recording 7.59 inches in 5.5 hours, which is close to a 25-year recurrence interval for 6 hours.

For model testing and validation, the historic operation of the DPS was carefully considered. DPS 07 and DPs 12 does not have its own standard set of operating rules (startup and shutoff depths and pumping capacity) nor a reliable method of estimating actual pumping rates such as an established pump curve, therefore a standard set of operating rules could not be established for the calibration events. Instead, pump operation was adjusted based on historic data, provided by SWBNO through the Pi system, for the September 2023 and April 2024 events, including intake levels and pump states. Since the provided data did not include flowrates, the pumping capacity was assumed to be 100 percent of the nameplate capacity for DPS 07 and DPS 12. A detailed description of schematization and pumps used in all runs is presented in TM2 (Appendix B).

Residents are encouraged to report drainage issues to 311 or their local council member. Lakeview neighborhood reports were documented and provided to Jacobs. Flooding issues were identified as hot spots. The ISeeChange platform was used to gather local flooding reports, including dates and photos. Photos from the platform were examined, and flooding locations were surveyed for water mark elevations during a May 15, 2024, field visit. Further details are in TM2 (Appendix B).

Validation events were simulated to compare the peak modeled water surface elevation (WSE) with elevations obtained from surveyed OWM elevations. Direct comparison of the modeled maximum WSE at the location of OWM points showed that the results were conservative with the model producing slightly greater flood depths. Comparison details are included in TM2 (Appendix B).

3.3 Storm Events

The production runs for the existing conditions modeling, selected in coordination with CNO, included the 1-year, 10-year, and 25-year, 24-hour storms. Rainfall depths were based on precipitation frequency estimates published in the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 (NOAA, 2018). Storm event details are in TM2 (Appendix B).

3.4 Existing Conditions Model Results

Figure 3-1 to Figure 3-3 illustrate the maximum flood depths in the study area for 1-year, 10-year, and 25-year events. The region between Filmore Avenue and Allen Toussaint Blvd. is highly susceptible to flooding. In contrast, the western part of Lakeshore, Lake Vista, experiences minimal flooding, even during a 25-year event. During a 10-year flood event, 16% of Lakeview experiences flooding exceeding 6 inches. For flood depths of 12 inches and 18 inches, the affected areas equal 7.2% and 2.8% of Lakeview, respectively. The greatest flood depths are observed on streets such as Milne Blvd., Marshall Foch Street, and Mouton Street, with maximum depths ranging from 2.5 feet for a 1-year event to 4.0 feet for a 25-year event. Table 3-2 details the existing conditions flood depth metrics.

Table 3-2. Existing Conditions Flood Depth Metrics

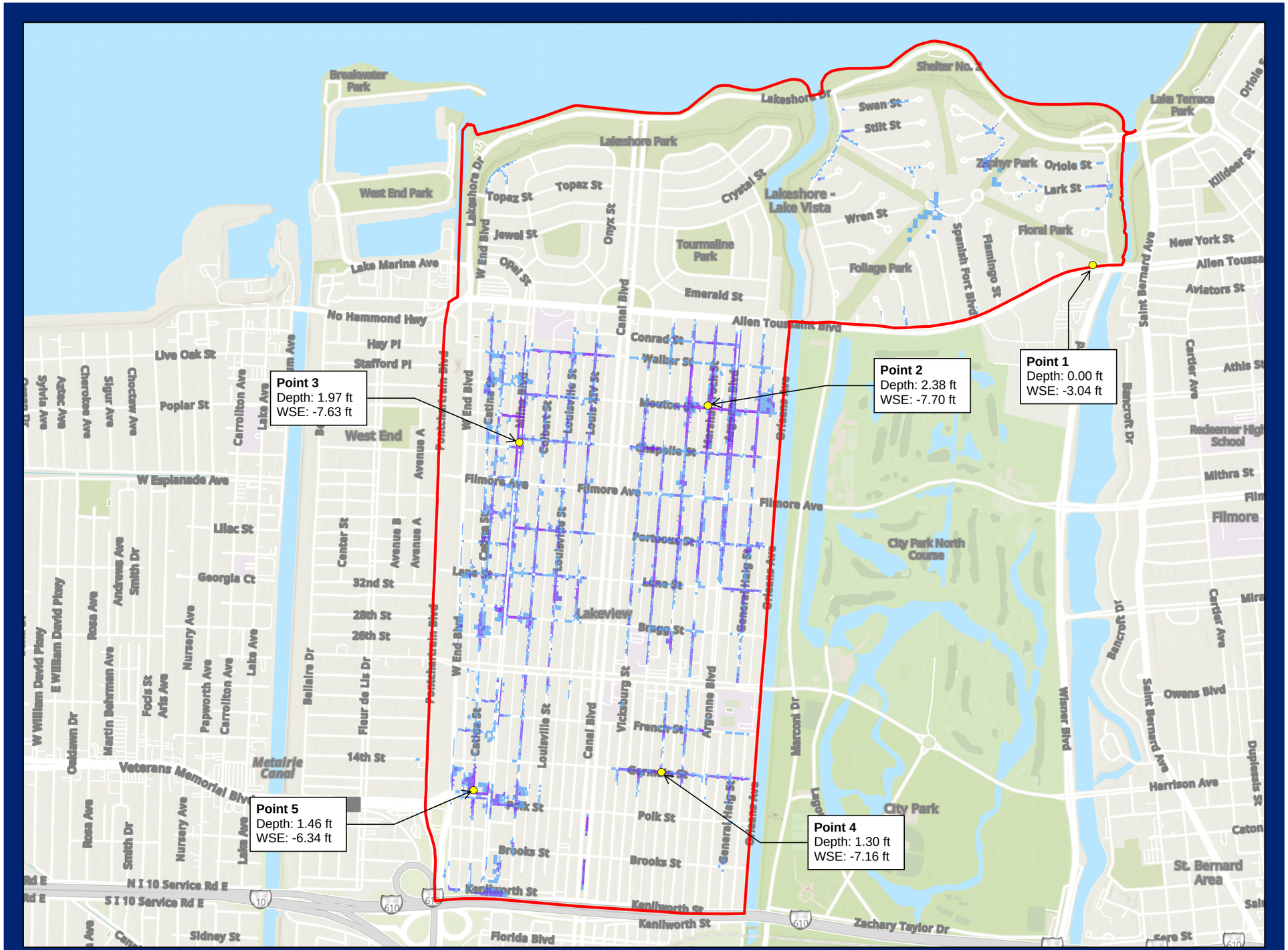
Flood Metric	1-Year	10-Year	25-Year
Max Flood Depth (ft)	2.45	3.65	4.03
Average Flood Depth where >1" (ft)	0.54	0.78	0.91
Flood Area > 6 inches (acres)	54.0	268.9	404.2
Flood Area > 12 inches (acres)	12.3	119.1	202.5
Flood Area > 18 inches (acres)	2.1	45.8	92.7
Flood Volume (MGAL)	20.9	112.1	171.5

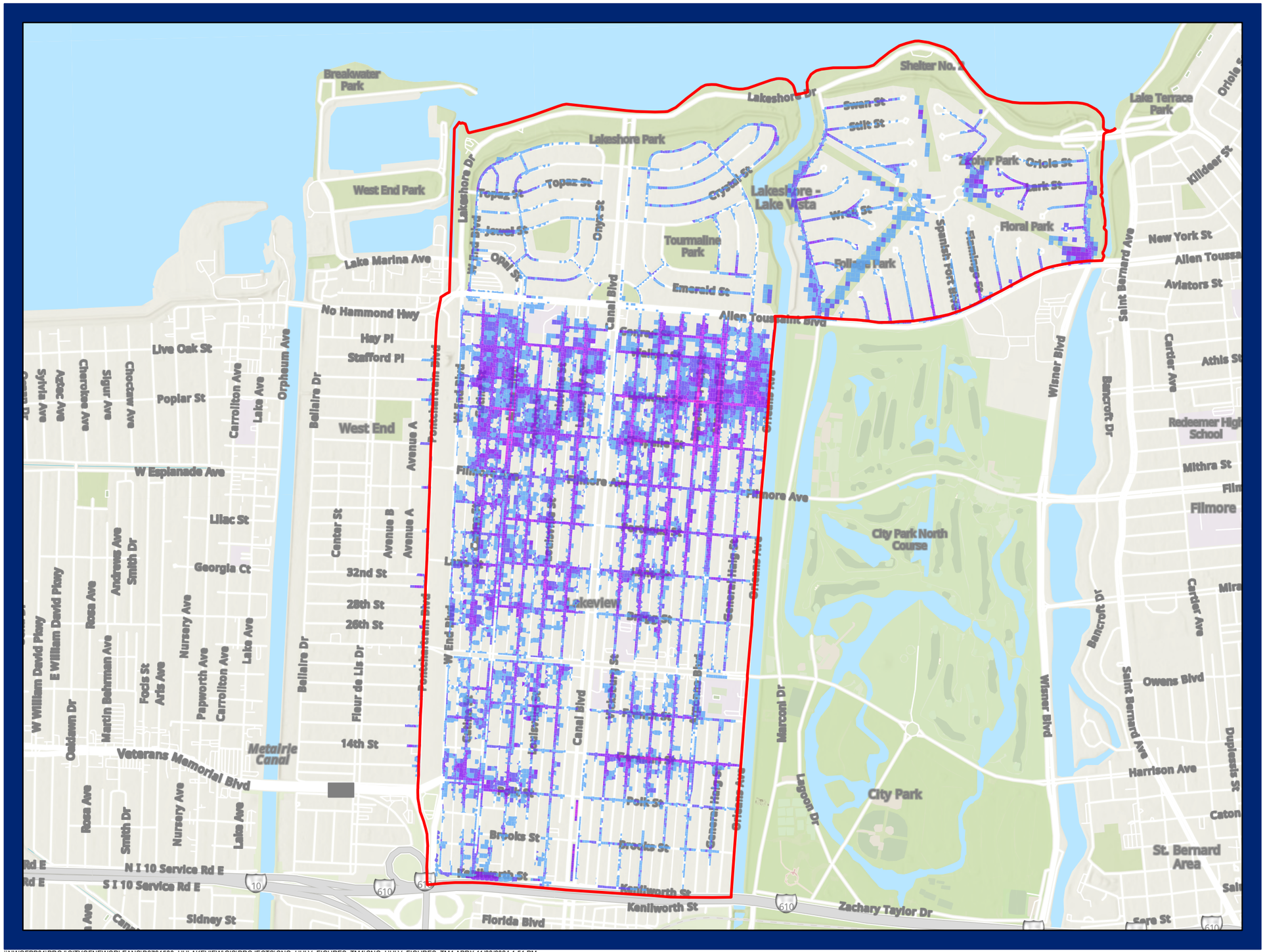
Areas that receive significant flooding for a 10-year event were identified as hot spots (see Figure 3-1 to Figure 3-3). Flood depths and WSE for these hot spots for the selected design events are summarized in Table 3-3.

- **Point 1** at the corner of Allen Toussaint Blvd. and Beauregard Avenue in Lake Vista receives flooding up to 1.77 feet. This point is located within area of low topography within Lake Vista.
- **Point 2** at Marshall Foch Street, close to Mouton Street, has a maximum flood depth of 3.58 feet. Generally, the area with Walker Street to the north, Chapelle Street to the south, Orleans Avenue to the east, and Memphis Street to the west has been observed to be the most susceptible to flooding. This point is located near hot spots identified through resident observation and near OWM 50002, 50003, 50004, 50005, and 50006.
- **Point 3** at Milne Blvd., close to Chapelle Street, receives flooding up to 3.02 feet. Maximum flood depths above 2 feet are observed along Milne Blvd. and Downs Street. Located near hot spot identified through 311 calls and councilman complaints. This point is located near hot spots identified through resident observations and near OWM 50013, 50014, and 50015.
- **Point 4** at Germain Street, close to General Diaz Street, has a maximum flood depth of 2.44 feet. A section of Germain Street between Vicksburg Street and Argonne Blvd. receives flooding that can exceed 1.5 feet. This point is located near hot spots identified previous modeling results.
- **Point 5** at Catina Street, close to Polk Avenue, receives flooding up to 1.97 feet. The area with flood depths exceeding 1.5 feet is confined to a small region around Point 5. This point is located near hot spots identified through previous modeling results and near OWM 50025, and 50026.

Table 3-3. Hot Spot Depth (WSE) in Feet

Event	Point 1 Lake Vista	Point 2 NE Lakeview	Point 3 NW Lakeview	Point 4 SE Lakeview	Point 5 SW Lakeview
1-year	0.00 (-3.04)	2.38 (-7.70)	1.97 (-7.63)	1.30 (-7.16)	1.46 (-6.34)
10-year	1.77 (-1.26)	3.58 (-6.50)	3.02 (-6.59)	2.44 (-6.01)	1.97 (-5.83)
25-year	1.94 (-1.09)	3.96 (-6.12)	3.40 (-6.20)	2.74 (-5.72)	2.15 (-5.64)


Point 1
Depth: 0.00 ft
WSE: -3.04 ft
Point 2
Depth: 2.38 ft
WSE: -7.70 ft
Point 3
Depth: 1.97 ft
WSE: -7.63 ft
Point 4
Depth: 1.30 ft
WSE: -7.16 ft
Point 5
Depth: 1.46 ft
WSE: -6.34 ft
Breakwater Park
West End Park
Lakeshore Park
Lakeshore - Lake Vista
Tourmaline Park
Foliage Park
Zephyr Park
Floral Park
Lake Terrace Park
Shelter No. 2
City Park North Course
City Park
Lakeview
West End
Metairie
New Orleans
Lakeshore Dr
Swan St
Stilt St
Oriole St
Lark St
Killdeer St
Wren St
Topaz St
Jewel St
Opal St
Crystal St
Onyx St
Emerald St
Canal Blvd
Conrad St
Walker St
Allen Toussaint Blvd
New York St
Aviators St
Spanish Fort Blvd
Flamingo St
Saint Bernard Ave
Bancroft Dr
Cartier Ave
Athis St
Redeemer High School
Mithra St
Filmore
Filmore Ave
Fortieth Ave
Cadiz St
Louisville St
Vicksburg St
Argonne Blvd
General Haig St
Orleans Ave
Marconi Dr
Wisner Blvd
Owens Blvd
Harrison Ave
Caton
Duplessis St
St. Bernard Area
Live Oak St
Poplar St
Hay Pl
Stafford Pl
No Hammond Hwy
Lake Marina Ave
Carrollton Ave
Lake Ave
Cherokee Ave
Sigur Ave
Choctaw Ave
Sylvia Ave
Aztec Ave
W Esplanade Ave
Lilac St
Georgia Ct
32nd St
28th St
26th St
14th St
Bellaire Dr
Fleur de Lis Dr
Center St
Avenue A
Avenue B
Andrews Ave
Smith Dr
Rosa Ave
Nursery Ave
Papworth Ave
Martin Behrman Ave
Focis St
Aris Ave
Oakdown Dr
W William David Pkwy
E William David Pkwy
Veterans Memorial Blvd
Metairie Canal
N I 10 Service Rd E
S I 10 Service Rd E
Sidney St
Florida Blvd
Kenilworth St
Zachary Taylor Dr
Eore St
Brooks St
Polk St
French St
Bragg St
Mouton St
Chapelle St
Perrpoint St
Lane St
Fillmore Ave
W End Blvd
Jahncke Ave
Calhoun St
Colbert St
Louisville St
Canal Blvd
Vicksburg St
Argonne Blvd
General Haig St
Orleans Ave
Marconi Dr
Wisner Blvd
Bancroft Dr
Saint Bernard Ave
Cartier Ave
Owens Blvd
Harrison Ave
Duplessis St
Caton
Athis St
Redeemer High School
Mithra St
Filmore
Lake Terrace Park
Killdeer St
Oriole St
Lark St
Zephyr Park
Floral Park
New York St
Aviators St
Saint Bernard Ave
Bancroft Dr
Cartier Ave



LEGEND

Project Area

10-Year, 24-Hour Existing Conditions Flood Inundation

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

N

0 0.25 0.5 Miles

Figure 3-2:
10-Year, 24-Hour Existing Conditions Flood Inundation
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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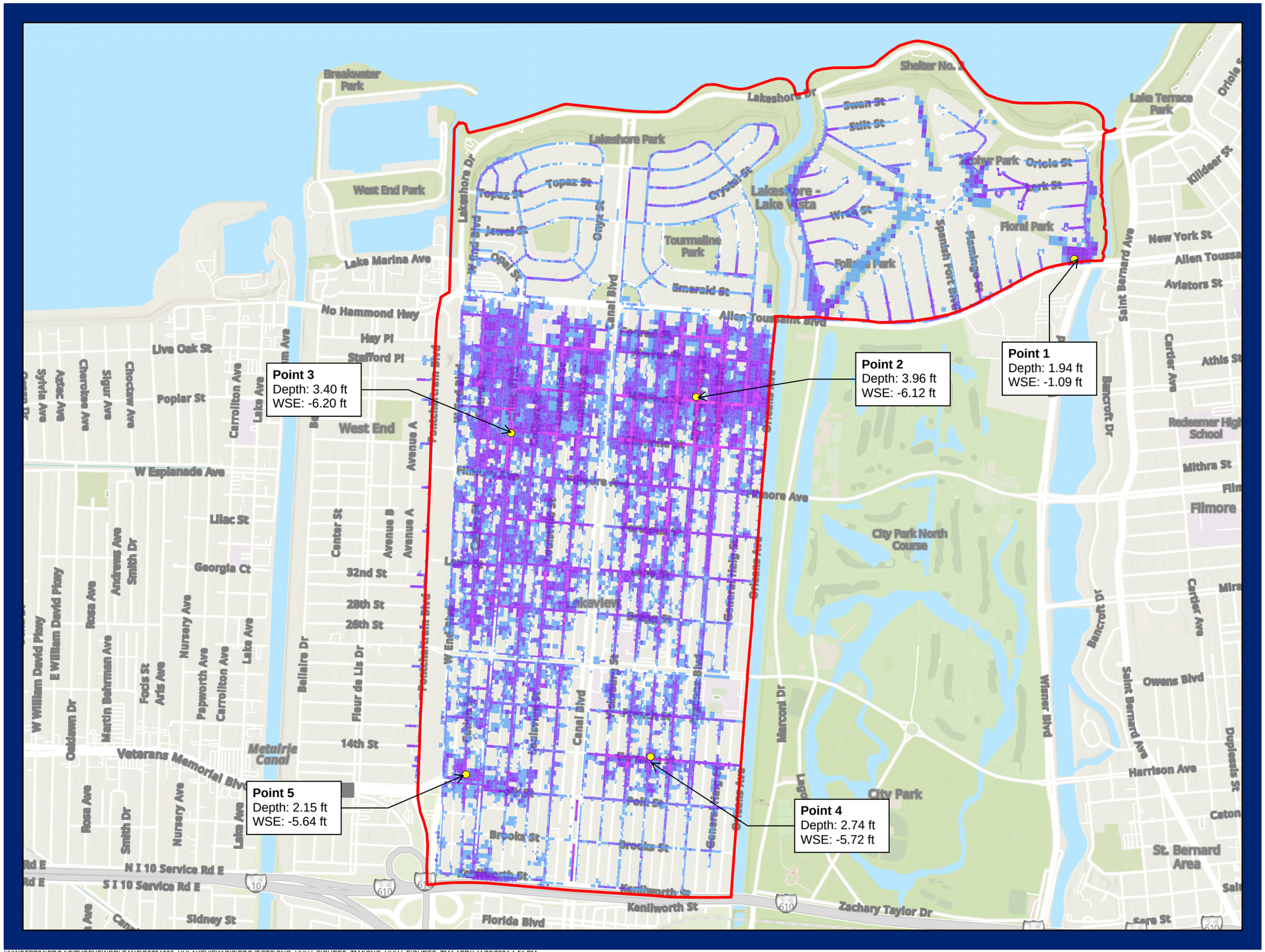

LEGEND

Project Area

25-Year, 24-Hour Existing Conditions Flood Inundation

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

Hot Spot Point

Figure 3-3:
25-Year, 24-Hour Existing Conditions Flood Inundation
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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3.5 Assessment of Existing Drainage System

Modeling of existing conditions revealed that the causes of flooding in the Lakeview area are related to deficiencies in both the major and minor drainage conveyance features, pumping capacity limitations at the system outfalls (DPS 07 and 12), and a lack of surface and subsurface storage within the system that would otherwise mitigate these deficiencies. These combined effects are further exacerbated by the hydrologic impacts of urbanization, non-stationary climate conditions, and low-lying topography.

The model results show that a backwater effect develops due to limited pumping capacity at both DPS 07 and DPS-12. The backwater effect forms mainly in the double barrel culvert (8.2 ft high and 7.5 ft wide) beneath Canal Blvd. This backflow extends to the intersection of Canal Blvd. and Toussaint Blvd., causing the water level to rise in the northern part of the Lakeview area, a region with the lowest elevation within the neighborhood. The backwater effect is observed even during frequently occurring 1-year events.

A model sensitivity, a Free Outfall scenario, was modeled to quantify how the limited pumping capacity at DPS 07 and DPS 12 impacts the flood depths and extents for the 10-year event. For this scenario, DPS 07 and DPS 12 were replaced with free outfalls to represent unlimited pumping capacity. Implementing free outfalls for a 10-year event significantly reduces the extent and depth of flooding compared to the existing condition model as shown in Table 3-4.

Table 3-4 Comparison of Free Outfall Conditions for the 10-year Event

Flood Metric	Existing Condition	Free Outfall Condition	% Reduction
Max Flood Depth (ft)	3.65	3.05	16%
Average Flood Depth where >1" (ft)	0.71	0.52	27%
Flood Area > 6 inches (acres)	264.6	158.1	40%
Flood Area > 12 inches (acres)	117.0	53.2	55%
Flood Volume (MGAL)	112.1	63.7	43%

The greatest flood depths, which exceeded 18 inches, were predominantly confined to sections of Marshall Foch Street, Mouton Street, and Milne Blvd. At hot spot locations, the maximum flood depth for the Free Outfall scenario remained unchanged at Point 1. However, at other locations there was a reduction in maximum flood depth ranging from 0.11 foot at Point 5 to 0.61 foot at Point 2.

The backwater effect observed under existing conditions was substantially reduced using the Free Outfall scenario, primarily within the major drainage structures. The backwater effect still occurs within the minor drainage system, highlighting areas of insufficient pipe sizing. This finding is consistent with CNO's 2012 Stormwater Management Capital Improvement Plan Stormwater Management Plan which contains detailed recommendations for pipe size increases for both major and minor drainage components contributing to both DPS-07 and DPS-12 (see TM1 in Appendix A for details).

Investigative runs were completed to assess hydrology and pump effects on Lakeview study area by turning off the rainfall directly to the Lakeview study area. This analysis showed BGSI alone would not remove all of the flooding within the study area

4. Project Opportunities

As described in Section 3.5, flooding within the Lakeview study area is caused by interrelated deficiencies including DPS capacity, major and minor conveyance deficiencies, and lack of surface and subsurface storage. While a significant contributor to flooding in the study area, a specific evaluation and associated recommendations for the improving DPS capacity was not considered within the scope of the study. Additionally, a renewed and review of the major and minor conveyance system would require more detailed evaluation of actual conditions (including clogging, sedimentation, disrepair, and collapse) coupled with conveyance estimates. These issues were partly addressed (conveyance capacity of major and minor features) in the *2012 Stormwater Management Capital Improvement Plan Stormwater Management Plan* (CDM Smith, 2012) as described above. Therefore, this study focuses on the third primary factor, lack of adequate surface and subsurface storage within the system through the implementation of blue-green stormwater infrastructure (BGSI) along with integrated conveyance improvements where necessary.

Blue-green stormwater infrastructure (BGSI) opportunities and integrated conveyance improvements were identified through a series of activities. Steps to identifying project opportunities included the creation of a Blue Green Stormwater Infrastructure (BGSI) toolbox, development of site typologies, a GIS analysis of the study area according to the site typologies, and an overlay of the hot spots identified through the existing conditions modeling. A variety of other feasibility and implementation factors were also considered in the initial identification of the project concepts that were carried forward for additional modeling, analysis, scoring, and ranking.

4.1 Blue-Green Stormwater Infrastructure (BGSI) Toolbox

Blue stormwater infrastructure (BSI) includes practices that collect and store rainwater without relying on vegetation and infiltration. Stormwater is temporarily stored in a BSI before and released at a slower rate into the downstream system. Examples of BSI include wet ponds, dry detention basins (referred to in this report as Stormwater Parks) and underground detention. Underground detention can take a variety of forms including chambered systems, large, interconnected box culverts or pipes, or modular tank systems. Many of these systems are propriety with numerous vendors providing bespoke solutions. Green stormwater infrastructure (GSI) includes practices that collect and retain stormwater runoff through storage and eventual infiltration. GSI practices, such as bioretention areas, provide enhanced water quality benefits compared to BSI practices since vegetation is an integral component. These water quality benefits are achieved through physical, chemical, and biological processes including settlement, pollutant degradation, and uptake of nutrients into biomass.

BSI and GSI are collectively referred to herein as BGSI toolbox practices. While this study primarily on reducing flooding, BGSI provide a range of benefits including the water quality benefits, mitigating urban heat island effects, and reducing subsidence risk by promoting infiltration and raising groundwater levels.

The BGSI toolbox consists of a screened list of potential BGSI practices that may have net improvements pertaining to flooding within the Lakeview planning area. To evaluate the feasibility and suitability of potential BGSI, screening criteria were necessary. During the workshop that took place on June 27, 2024, these criteria were presented along with model results from Task 2. The screening criteria included the following:

- **Environmental Factors:** Considerations including the suitability of BGSI practices for flood-prone areas and their effectiveness in managing stormwater volume

- **Economic Factors:** Evaluation of long-term operations and maintenance (O&M) requirements and potential challenges related to the implementation of BGSI practices
- **Community Buy-in:** Assessment of community acceptance and support for BGSI practices, ensuring that residents and stakeholders are willing to adopt and maintain these measures

The initial list of practices included in the BGSI toolbox are summarized in Table 4-1, which include practices previously developed by CNO for application throughout the City. These practices have been deemed suitable based on environmental or performance-related factors, economic factors (including maintenance and implementation challenges), and social factors (including likely community acceptance). Details of the BGSI practices in the toolbox are provided in Appendix C.

BGSI practices are broadly categorized into surface, subsurface, and parcel-based practices. Surface BGSI practices store water above ground or through plant absorption. Subsurface BGSI practices store water below ground or promote infiltration into the soil. Parcel-based BGSI are smaller community-implemented projects that can help alleviate flooding on individual properties.

Comments collected during the workshop are included in Appendix D. Based on comments and feedback received during the workshop, detention basins, stormwater parks, bioretention, bioswales, tree planting, planter boxes, and modular tank systems, among others, were deemed favorable and feasible.

Table 4-1. BGSI Practices

Type	Surface	Subsurface	Parcel-Based
Blue	▪ Detention basin* ▪ Stormwater park ▪ ~~Passable streets~~	▪ Modular Tank System ▪ Box culvert street	
Green	▪ ~~Tree planting~~ ▪ ~~Tree boxes*~~ ▪ ~~Curb stormwater box*/tree trench~~ ▪ Bioretention* ▪ Vegetated bioswale*	▪ Permeable pavement* ▪ ~~Infiltration trench*~~ ▪ ~~Subsurface infiltration chamber~~	▪ Downspout disconnection ▪ Rain barrel/cisterns ▪ Stormwater planter box* ▪ Sunken garden ▪ Green roof

Note: The GSI practices developed by CNO that are included in the BGSI toolbox are marked with asterisks. Practices eliminated from consideration in the workshop screening are shown with a strikethrough.

4.2 Site Typologies

Site typologies play a crucial role in the implementation of BGSI practices. Site typologies help identify suitable locations for various BGSI measures, ensuring they are effectively integrated into the urban landscape to maximize stormwater management benefits. The following site typologies were considered for BGSI implementation:

- **ROW Strips**: Narrow strips of land typically found between sidewalks and streets, ideal for bioretention practices and tree planting
- **Neutral Grounds**: Central medians in roadways that can accommodate larger BGSI practices such as stormwater parks and detention basins

- **Parking Areas/Empty Lot**: Underutilized or excess pavement areas that can be converted into permeable pavement, subsurface storage, bioretention, infiltration trenches or even converted into stormwater parks to manage runoff
- **Schools and Parks**: Open spaces that provide opportunities for community based BGSI projects like rain gardens, bioswales, and tree trenches or subsurface storage.
- **Residential Properties**: Individual properties where parcel based BGSI practices such as rain barrels, cisterns, and downspout disconnections can be implemented to reduce localized flooding
- **Commercial Properties**: Business areas that can integrate BGSI practices such as green roofs, permeable pavements, and stormwater planters to manage runoff and enhance urban aesthetics

4.3 Feasibility and Implementation Constraints

Feasibility constraints and considerations that may impact project implementation include the following:

- **Proximity to Trees:** Proximity to existing trees can impact root systems and the suitability of certain BGSI measures. Areas within the drip line of existing trees were considered, using tree shapefiles available via CNO GIS.
- **Elevation:** The site's elevation affects water flow and the effectiveness of stormwater management practices. Lower-elevation areas were prioritized using data from the 2021 Louisiana Department of Transportation and Development (LaDOTD) LIDAR (OCM Partners, 2021).
- **Hydrologic Soil Properties:** Soil characteristics such as permeability and infiltration rates determine the suitability of infiltration-based practices. Primarily poorly draining soils within Lakeview were identified using USGS Web Soil Survey data (Soil Survey Staff, 2019).
- **Slope:** The gradient of the site influences water runoff and the design of BGSI measures. Areas with a gradient towards the site were identified using data from the 2021 Louisiana Department of Transportation and Development (LaDOTD) LIDAR (OCM Partners, 2021).
- **Utilities:** The presence and depth of existing utilities can significantly affect the placement and type of BGSI practices. Due to insufficient data available for desktop analysis, utilities criterion was not used.
- **Depth to Groundwater:** The distance from the surface to the groundwater table influences the feasibility of subsurface practices. This criterion was not used due to a lack of available data for desktop analysis.
- **Subsidence:** Areas prone to subsidence, where ground movement could impact the stability and longevity of BGSI installations, were considered. However, this criterion was not used due to insufficient data available for desktop analysis.

4.4 Potential Concept Locations

Each site typology was reviewed based on CNO GIS data to evaluate its potential to support specific BGSI practices and determine 20–30 possible site locations available within the Lakeview study area. Feasibility conditions were established, and preliminary opportunities identified through desktop screening. Site typology and feasibility maps are located on the Jacobs ArcGIS portal for CNO. Ultimately, 12 concepts were carried forward for concept development, modeling, and scoring.

https://amergis.jacobs.com/portal/apps/mapviewer/index.html?webmap=3a0115cdc2874bbd8c23a49df89ae321

While this study focused on identifying opportunities with the largest potential to reduce flooding, this database can be further accessed and refined when identifying and evaluating opportunistic implementation of BGSI within the study area (e.g. partnered with other infrastructure improvements) or programmatic implementation strategies such as residential rebate programs, capital project integration of green infrastructure, incentive-programs, etc. to implement more broadly smaller scale green infrastructure to reduce the load on the drainage system.

4.5 Concept Opportunities Selected for Further Development

The study area was divided into two regions: Lakeshore/Lake Vista and Lakeview. Lakeshore and Lake Vista, which are generally considered upstream in the system, present opportunities to reduce contributions to flooding in Lakeview through strategic storage solutions. An overview of project concepts, including location and description, is provided Table 4-2, and concepts are detailed in Section 6.1. Specific project locations are shown in Figure 4-1.

Key areas with the greatest flood depth were identified for targeted mitigation. For example, water storage is proposed along the West End Blvd neutral ground, formerly part of New Basin Canal (Preservation Resource Center of New Orleans, 2019) to reduce flooding in the surrounding neighborhood while also enhancing the park's aesthetic value. Several green spaces were chosen for their social and strategic benefits (Harlequin, Tourmaline, and Tiara / Peridot Parks), and partnering with local institutions (Hynes Elementary School) to implement BGSI will bring positive local attention to the projects, serve as a learning tool for the community, and make it possible to store excess water volume.

Table 4-2. Concept Overview

ID	BGSI Location	Description
1	Harlequin Park	Modular tank system, flow splitter structure, flow control structure
2	Tourmaline Park	Modular tank system, flow splitter structure, flow control structures
3A	Tiara and Peridot Park - Inline	Inline stormwater park acting as a surcharge pond, pipe rerouting, flow spitter structure, flow control structure
3B	Tiara and Peridot Park - Offline	Offline stormwater park, pipe rerouting, flow spitter structure, flow control structure
4	Marconi Levee	Stormwater park, flow splitter structure, flow control structure
5	Upper West End	Stormwater park, flow splitter structure, flow control structure
6	Mouton Street	Modular tank system, conveyance upgrades
7	Harrison Avenue	Conveyance upgrades, permeable pavement, sunken gardens
8	Hynes Elementary School	Modular tank system, green roof, bioswales
9	Germain Street	Modular tank system, conveyance upgrades, flow splitter structure, flow control structure
10	Canal Blvd.	Open box culvert, upsize box culvert
11	New Basin Canal	Stormwater park, conveyance upgrades, flow control structure
12	Kenilworth Street	Stormwater park, flow splitter/control structure

LEGEND

Project Area

Pumps

BGSI Location

- Box Culvert
- Modular Storage System
- Green Roof
- Sunken Garden
- Stormwater Park
- Vegetated Bioswale

N

0 0.1 0.2 0.3 Miles

Figure 4-1:
BGSI Location
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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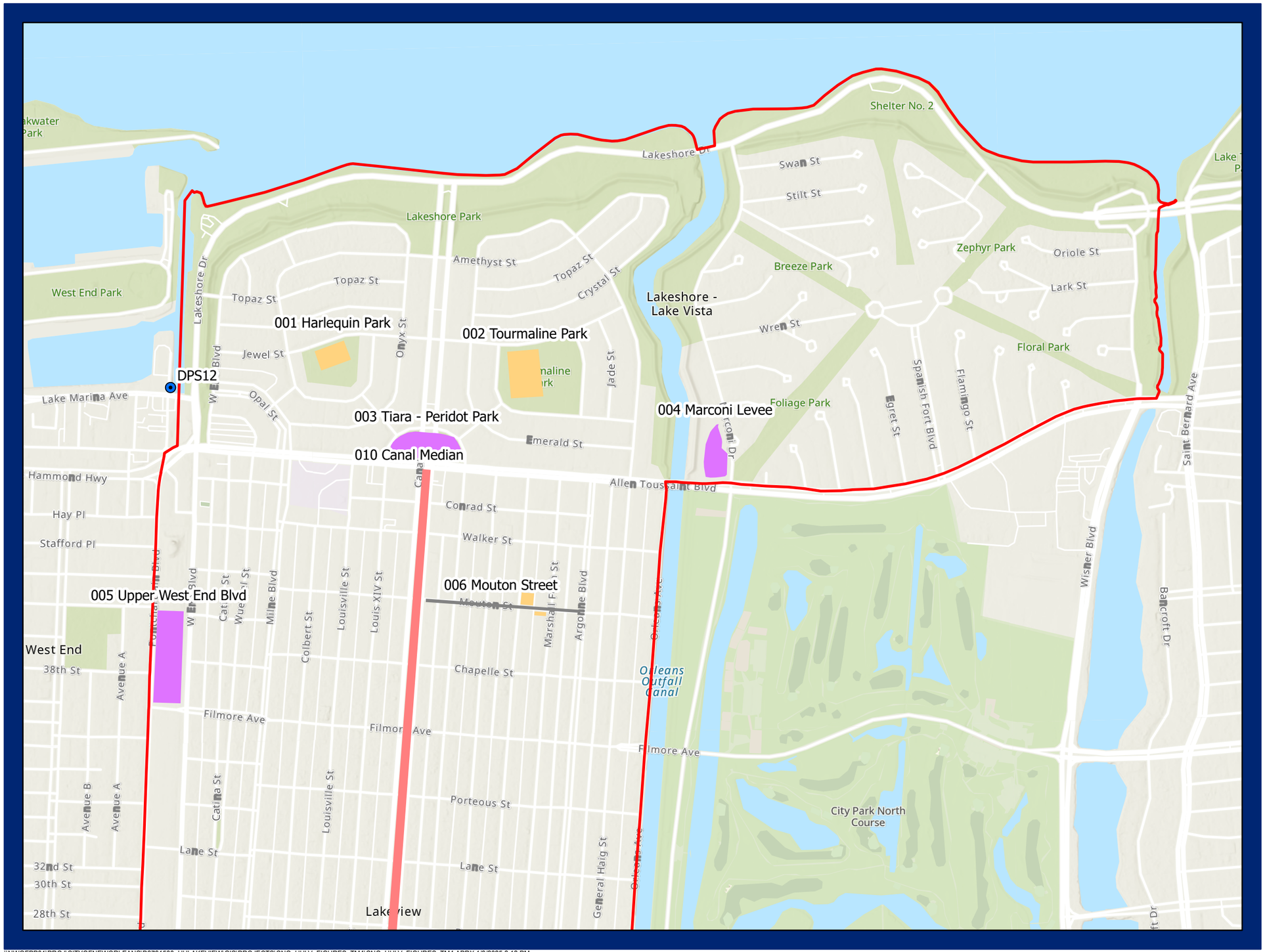

LEGEND

Project Area

Pumps

BGSI Location

- Box Culvert
- Modular Storage System
- Green Roof
- Sunken Garden
- Stormwater Park
- Vegetated Bioswale

N

0 0.1 0.2 0.3 Miles

Figure 4-2:
Lake Vista / Lake Shore and North Lakeview Concept Locations

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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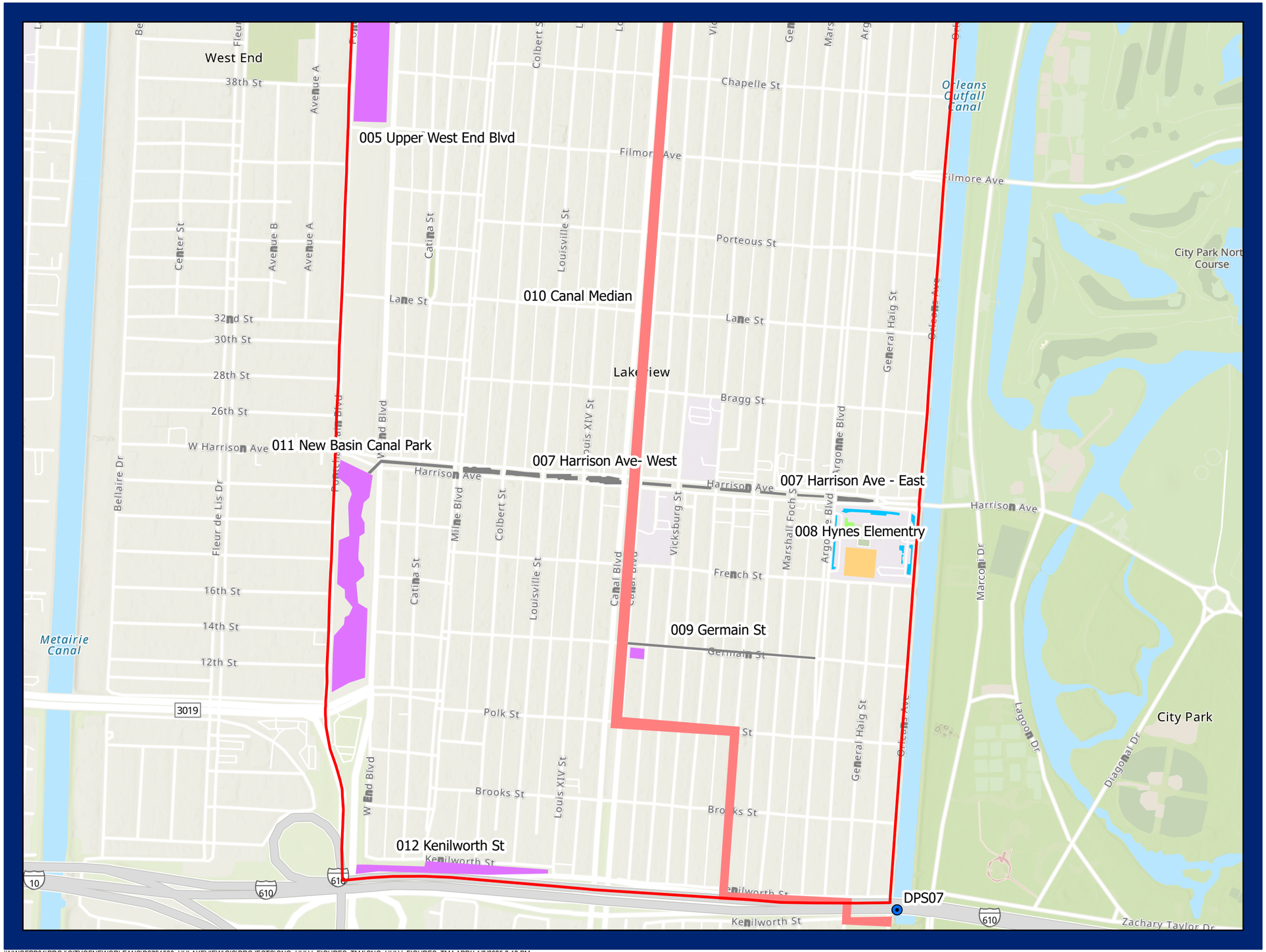

LEGEND

Project Area

Pumps

BGSI Location

- Box Culvert
- Modular Storage System
- Green Roof
- Sunken Garden
- Stormwater Park
- Vegetated Bioswale

N

0 0.1 0.2 0.3 Miles

Figure 4-3:
Lakeview South Concept Locations
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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5. Concept Modeling and Analysis

5.1 Overview of Concept Modeling

The hydraulic benefits of the projects described in Section 4 were evaluated using the previously updated and validated existing conditions PCSWMM model for the 10-year, 24-hour design storm. Further details of the concepts were developed including connectivity to the existing drainage infrastructure, storage volumes, and inlet and outlet controls. Although numerous permutations and combinations of concepts could be developed as alternatives, the hydraulic benefits were assessed by modeling each concept individually. A combined suite of concepts was ultimately modeled to understand the collective benefits of the projects.

Concept modeling also considered various boundary conditions including the current pump system as well as a scenario that represented future capacity upgrades, that is a "free outfall" scenario. Modeling of various boundary conditions provided an understanding of how the interconnected system of pipes, pumps, and BGSI measures influence flooding in the area under both existing conditions as well as if future pump capacity improvement could be achieved. A quantitative evaluation of the modeling results based on various flood metrics was conducted as described below.

Since the focus was primarily on BGSI concept opportunities, a evaluation of conveyance limitations, including the potential for clogged or collapsed piping, was not directly performed. This would require a more focused modeling effort together with a more exhaustive field survey and condition assessment of both major and minor drainage infrastructure. Conveyance improvements were evaluated to an extent when included as components of the BGSI projects, which will be discussed in greater detail for their concept designs in Section 6.

Models are submitted as an electronic appendix and details are in Appendix I.

5.2 Model Results

5.2.1 Flood Mapping

Flood Maps associated with project modeling results are found in Appendix F. Appendix F.1 provides flood inundation maps and Appendix F.2 provides a comparison with existing conditions (i.e., difference maps) for both individual and combined concepts.

5.2.2 Flood Metrics

A set of flood metrics, described below, were developed to quantity hydraulic benefits. Flood metrics include maximum reduction for the overall study area and at identified hot spots, average reduction for the overall study area and at identified hot spots, area of flood reduction as quantified and depicted in the inundation maps, and flood volume reduction for the study area.

5.2.2.1 Max Flood Depth Reduction

- This metric measures the maximum decrease in flood depth achieved by a specific project across the study area. The peak depth of flood from the concept model results is compared to the peak depth of flood from the existing conditions model results to determine the maximum reduction in flood depth. This comparison determines the maximum reduction in depth throughout the overall model. A similar method

is used to calculate the maximum reduction at identified hot spots within the study area. It is important to note that this analysis did not consider the timing of the peak within the time series of the model; rather, it was based solely on peak values. Results found in Table 5-1.

5.2.2.2 Average Flood Depth Reduction

- This metric measures the mean decrease in flood depth achieved by a specific project across the study area. The average reduction was calculated through GIS spatial analysis by subtracting flood depth from the concept models from the existing conditions model at each 2D cell. The average reduction was calculated by determining the mean of all cells with a reduction greater than 1 inch. The average of these reductions provides an assessment of the project's effectiveness in reducing flood levels throughout the area. By considering the average reduction, the general improvement in flood conditions rather than focusing solely on the maximum reduction at specific locations could be assessed. Results found in Table 5-1.

5.2.2.3 Area of Flood Reduction

- This metric measures the total area within the project area where flood depths have been reduced by a specific project. The area of flood reduction is quantified by comparing the inundation extents from the concept model results to those from the existing conditions model results. Using GIS spatial analysis, the Jacobs team could identify the areas where flood depths have decreased and sum them to determine the total acreage of flood reduction. This metric provides an indication of the spatial extent of the reduced flood impacts across the study area. To represent meaningful flood reduction, only the areas where flooding was reduced by greater than 1 inch was calculated. Results found in Table 5-1.

5.2.2.4 Flood Volume Reduction

- This metric measures the total volume of floodwater reduced by a specific project measured in million gallons (MGAL). The flood volume reduction was determined by calculating the volume reduction at each 2D cell using the maximum depth reduction and the area of the 2D cell. These individual volume reductions were then summed to obtain the total flood volume reduction. This metric helps to quantify the overall effectiveness of the project in reducing the amount of floodwater within the study area and the amount of floodwater reaching the DPS, providing an assessment of its impact. For example, the benefits of reduced flood volume relate to a reduced duration of flooding since runoff must be pumped out of the system. Results found in Table 5-1.

5.2.2.5 Hot Spot Flood Depth Reduction

- Hot spot reduction was developed using the methodology of max reduction analysis in the hot spot locations determined in Section 3.4. Results found in Table 5-2.

5.2.2.6 Hot Spot Flood Depth Percent Reduction

- This metric measures the percent flood depth reduction achieved by a specific project at a given 2D cell or located at a hot spot location. The reduction in flood depth at a 2D cell or at the hot spot location is divided by the flood depth at that location to determine the percent depth reduction. It is an instantaneous calculation where the peak depth of flood reduction calculated in Section 5.2.1.5 from the concept model results is divided by the peak depth of flood from the existing conditions model results. This comparison determines the percentage in depth reduction at a specified point. Results are shown spatially on the maps in F.2.

5.2.2.7 Flood Extent Reduction

- The areal extent of flooding was calculated by summing the area of 2D cells that experienced two different levels of flood reduction: flood reduction greater than 1 percent (relative to existing flood depth) and greater than 50 percent. As an example, if the existing flood depth was estimated at 2 feet and the reduction in peak flood depth resulting from the concept was 1 foot, the flood depth reduction for this cell would be 50 percent. Additional comparisons could be made; however, the small percent reduction indicates that a proposed project has some effect on the area whereas the larger percent reduction would indicate meaningful flood reductions (i.e., flooding reduced by half. Results found in Table 5-3.

5.2.3 Flood Metric Results

This section summarizes the performance of each concept based on flood metrics for the 12 individual concept (1 through 12) as well the combination of all concepts for two different boundary conditions (13 and 14). Soft cost versus flood metrics are comprehensively detailed in Table 7-9.

Table 5-1. Concept Modeling Flood Metric Results

ID	Concept Name	Max Depth Reduction Feet (inches)	Average Depth Reduction Feet (inches)	Area of Flood Reduction >1 Inch (acres)	Flood Volume Reduced (MGAL)
1	Harlequin Park	-0.5 (-6)	-0.2 (-2)	6.4	1.9
2	Tourmaline Park	-0.3 (-4)	-0.1 (-2)	1.2	2.3
3A	Tiara and Peridot Park Inline	-0.8 (-10)	-0.2 (-3)	1.0	0.2
3B	Tiara and Peridot Park Offline	-0.3 (-3)	-0.1 (-2)	0.6	1.1
4	Marconi Levee	-1.1 (-14)	-0.2 (-2)	14.1	1.6
5	Upper West End	-0.5 (-6)	-0.2 (-2)	0.7	2.0
6	Mouton Street	-0.3 (-3)	-0.2 (-2)	0.3	1.0
7	Harrison Avenue	-0.5 (-6)	-0.1 (-2)	2.2	2.7
8	Hynes Elementary School	-0.2 (-2)	-0.1 (-2)	0.2	0.8
9	Germain Street	-0.2 (-2)	-0.2 (-2)	0.0	0.7
10	Canal Blvd.	-0.7 (-9)	-0.1 (-1)	24.5	0.4
11	New Basin Canal	-0.5 (-6)	-0.1 (-1)	37.5	4.9
12	Kenilworth Street	-1.5 (-18)	-0.4 (-4)	5.8	2.2
13	Combined	-1.5 (-18)	-0.1 (-1)	410.0	14.8
14	Combined with “Free Outfall”	-1.9 (-23)	-0.5 (-6)	452.7	64.1

Table 5-2. Concept Modeling Hot Spot Depth (Reduction) in Feet

Concept	Point 1 Lake Vista	Point 2 NE Lakeview	Point 3 NW Lakeview	Point 4 SE Lakeview	Point 5 SW Lakeview
10-Yr Existing Conditions Max Depth	1.77	3.58	3.02	2.44	1.97
1 Harlequin Park	1.77(0)	3.56 (-0.02)	3.01 (-0.01)	2.43 (-0.01)	1.97 (0)
2 Tourmaline Park	1.76 (-0.01)	3.55 (-0.03)	3 (-0.02)	2.43 (-0.01)	1.97 (0)
3A Tiara and Peridot Park Inline	1.76 (-0.01)	3.57 (-0.01)	3.02 (0)	2.42 (-0.02)	1.96 (-0.01)
3B Tiara and Peridot Park Offline	1.76 (-0.01)	3.56 (-0.02)	3.01 (-0.01)	2.43 (-0.01)	1.97 (0)
4 Marconi Levee	1.63 (-0.14)	3.57 (-0.01)	3.02 (0)	2.44 (0)	1.97 (0)
5 Upper West End	1.77 (0)	3.57 (-0.01)	2.99 (-0.03)	2.44 (0)	1.97 (0)
6 Mouton Street	1.77 (0)	3.56 (-0.02)	3.02 (0)	2.44 (0)	1.97 (0)
7 Harrison Avenue	1.77 (0)	3.55 (-0.03)	3 (-0.02)	2.43 (-0.01)	1.97 (0)
8 Hynes Elementary School	1.76 (-0.01)	3.57 (-0.01)	3.02 (0)	2.43 (-0.01)	1.97 (0)
9 Germain Street	1.77 (0)	3.57 (-0.01)	3.02 (0)	2.42 (-0.02)	1.97 (0)
10 Canal Blvd.	1.76 (-0.01)	3.57 (-0.01)	3.05 (0.03)	2.35 (-0.09)	1.96 (-0.01)
11 New Basin Canal	1.76 (-0.01)	3.57 (-0.01)	2.94 (-0.08)	2.44 (0)	1.95 (-0.02)
12 Kenilworth Street	1.76 (-0.01)	3.57 (-0.01)	3.01 (-0.01)	2.44 (0)	1.95 (-0.02)
13 Combined	1.63 (-0.14)	3.47 (-0.11)	2.91 (-0.11)	2.31 (-0.13)	1.93 (-0.04)
14 Combined with "Free Outfall"	1.54 (-0.23)	2.69 (-0.89)	2.21 (-0.81)	1.51 (-0.93)	1.89 (-0.08)

Table 5-3. Flood Extent Reduction at > 1% and > 50% Depth Reduction Percentage

ID	Concept Names	Depth Reduction >1%		Depth Reduction >50%	
		Area (acres)	Number of 2D cells	Area (acres)	Number of 2D cells
1	Harlequin Park	268.0	9,538	8.3	270
2	Tourmaline Park	343.6	12,651	10.2	312
3A	Tiara and Peridot Park Inline	192.4	6,864	4.2	139
3B	Tiara and Peridot Park Offline	258.9	9,216	4.4	145
4	Marconi Levee	129.4	4,349	6.2	198
5	Upper West End	239.8	8,556	7.7	228
6	Mouton Street	154.4	5,658	2.7	90
7	Harrison Avenue	325.5	12,086	10.4	323
8	Hynes Elementary School	138.7	4,915	1.9	74
9	Germain Street	132.6	4,716	1.6	55
10	Canal Blvd.	195.3	7,057	10.5	373
11	New Basin Canal	292.9	10,577	21.9	676
12	Kenilworth Street	252.9	8,782	7.6	225
13	Combined	439.6	16,338	76.4	2,450
14	Combined with "Free Outfall"	460.0	17,028	323.7	11,538

5.3 Results Analysis

The analysis of the modeling results for the 12 individual concepts and a combined model (Concept 13) provided valuable insights into their flood mitigation effectiveness.

5.3.1 Individual Concepts

5.3.1.1 Max Depth Reduction Results

Concept 12 Kenilworth Street has the highest maximum reduction in flood depth at 1.5 feet (18 inches). This concept is designed to reduce immediate flooding upstream of DPS 07 by storing flow during the peak of the event. The high maximum reduction value indicates its effectiveness in holding water upstream until the peak subsides, thereby mitigating the impact of flooding downstream. Concept 4 Marconi Levee also demonstrates a high maximum reduction in flood depth at 1.1 feet (14 inches). This concept is located in the Lake Vista area and is designed to reduce flow to DPS-12 and downstream flooding by storing flow during the peak of the event. The location of each of these concepts is notable in that they appear to be less hydraulically sensitive to the backwater conditions created by the DPSs and downstream conveyance system. This suggests that these projects have the greatest benefit if pursued independent of improvements to the DPSs and major conveyance downstream.

5.3.1.2 Average Depth Reduction Results

Most concepts have an average reduction of 0.1 to 0.2 feet (1 to 2 inches), indicating a modest but consistent decrease in flood depth across the study area. However, without a thorough condition and capacity assessment of the existing stormwater collection system as well as any necessary DPS capacity improvements, backwater conditions along the backbone of the system will persist, resulting in lower average reductions.

5.3.1.3 Area of Flood Reduction Results

Concept 11 New Basin Canal stands out due to its significant area of flood reduction of 37.5 acres and flood volume storage capacity of 4.9 MGAL, indicating a broad spatial impact. The additional storage capacity and improved conveyance at this location significantly impact a noted hot spot along Harrison Avenue. The area of flood reduction is larger here due to the volume of water that previously inundated this area. This concept highlights the effectiveness of using targeted interventions in low-lying areas to achieve broader flood mitigation benefits.

5.3.1.4 Flood Volume Reduction Results

Concept 7 Harrison Avenue is notable for its role in flood volume storage as part of the backbone of the stormwater system. It demonstrates a flood volume reduction of 2.7 MGAL, highlighting its effectiveness in reducing the overall floodwater volume. This concept helps manage intense backwater conditions and supports the system's capacity to handle large volumes of water.

5.3.1.5 Flood Reduction at Hot Spots

The hot spot results indicate that the Concept 4 Marconi Levee is most effective in the Lake Vista area by reducing the hot spot by reducing peak flood depth by 0.14 ft, and the Concept 11 New Basin Canal is most effective in NW Lakeview by reducing peal flood depth by 0.08 ft. These findings suggest that these two projects are the most effective in mitigating flooding near the respective locations. Many of the hot spots resulted in a minimal flood depth reduction. The hot spot areas are in topographic depressions in the study area making them more prone to flooding and less sensitive to drainage solutions.

5.3.2 Combined Concepts

Modeling of the combined concepts revealed several key findings as summarized below. Table 5-4 summarizes the various flood metrics for existing conditions (or baseline model), existing conditions under a free outfall scenario, with project conditions including all projects, and with project conditions including all projects and a free outfall condition.

- **Combined Benefits** - The combined concept reduced flooding by over 1 inch across 410 acres of the study area. Additionally, the combined concept reduced water volume by over 14 million gallons (MGAL), or roughly 68 percent of the volume reduced by the sum of the individual concepts. Suggesting some redundancy in flood volumes reduced.
- **Gray-Green Synergy** - When simulated with a free outfall scenario, BGSI reduced flooding by 64.1 MGAL compared to 14.8 MGAL under current pumping conditions. This scenario showed greater than 50% flood reduction across four times more land area than BGSI alone.

- **Decentralization Benefits** - BGSI works best when implemented across multiple sites. This approach helps distribute the water storage network, easing pressure on the main system.
- **Ongoing Challenges** - Even with free outfall conditions, the 10-year flood event wasn't completely mitigated. Additional improvements in conveyance, storage, and GSI are needed for additional flood alleviation. Some areas face persistent elevation challenges that improvements cannot completely resolve.
- **Comparative Performance** - The Combined Concept consistently showed the highest performance across all flood metrics. With free outfalls, it reduced flooding more than 6 inches from 14.5% to 7.5% of the study area. For flood depths more than 12 inches and 18 inches, reductions were 6.2% to 2.1% of the study area and 2.3% to 0.4%, respectively. Significant flooding (above 2 feet) was limited to one intersection (at Mouton and Marshall Foch Streets).
- **Future Needs** -More projects are needed to achieve the city's goal of no more than 6 inches of flooding in a 10-year, 24-hour storm.

Table 5-4. Combined Concepts Model Results Summary

Flood Metrics	Existing Conditions	Existing with Free Outfall	With Combined Concepts	With Concept and Free Outfall
Flood Volume (MGAL)	112.1	63.7	97.3	48.0
Reduction (MGAL)	NA	48.4	14.8	64.1
Percent Reduction	NA	43%	13%	57%
Flood Extent > 1' (Acres)	117.0	53.2	98.7	32.3
Reduction (MGAL)	NA	63.8	18.3	84.7
Percent Reduction	NA	55%	16%	72%
Flood Extent > 0.5' (Acres)	264.6	158.1	232.0	120.7
Reduction (MGAL)	NA	106.4	32.6	143.9
Percent Reduction	NA	40%	12%	54%
Flood Extent > 0.25' (Acres)	384.6	247.9	342.5	200.6
Reduction (MGAL)	NA	136.8	42.1	184.1
Percent Reduction	NA	40%	11%	74%
Peak Flood Depth (feet)	3.65	3.05	3.54	2.76
Percent Reduction	NA	16%	3%	24%
Average Depths of Flooding Over Entire Area (feet)	0.21	0.12	0.16	0.07
Percent Reduction		43%	24%	68%
Average Flood Depths over Flooded Area (feet)	0.71	0.52	0.66	0.44
Percent Reduction		27%	7%	38%

6. Concept Development

This section provides detailed descriptions of the proposed concept projects, including location, type, layout, project results, cost estimates and future design and implementation considerations. These projects aim to address the identified flooding challenges through a combination of surface and subsurface storage together with localized conveyance improvements. The modeling results were previously detailed in Section 5.2.

6.1 Concept Details

Concept details are presented in the following pages through a series of project sheets. Locations are shown in Figure 4-1. The concept layouts provided are excerpts from the 10% concept plans provided in Appendix E.

Concept 1 - Harlequin Park		
Location	Harlequin Park bounded by Jewel Street (north), Cameo Street (west), Turquoise Street (south), and Beryl Street (east) in Lakeshore	
BGSI Type	Modular tank system, flow splitter structure, flow control structure	
Solution	Storage volume for runoff from Lakeshore to reduce flow at DPS 12 and DPS 07	
Estimated Soft Cost	$1,072,400 - $2,010,750	
Estimated Construction Cost	$3,064,000 - $5,745,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-7
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	6.4
	Flood Volume Reduced (MGAL)	1.9

Concept Description

Concept 1, Harlequin Park, would divert water from the existing pipe system along Cameo Street and Jewel Street. During high-water events, flow would be diverted via flow splitter through approximately 330 feet of new 30-inch-diameter pipe along Jewel Street into a 2.1-million-gallon (MGAL) subsurface modular storage system within Harlequin Park. The new storage system would discharge toward Turquoise and Zircon Street through approximately 400 feet of 18-inch diameter pipe. Outflow from the storage system would be controlled by an outlet control structure containing an orifice (or active controls) and an overflow weir/riser that would release stormwater after the downstream water levels recede. After a storm event, the tank system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing the hydraulic benefit.

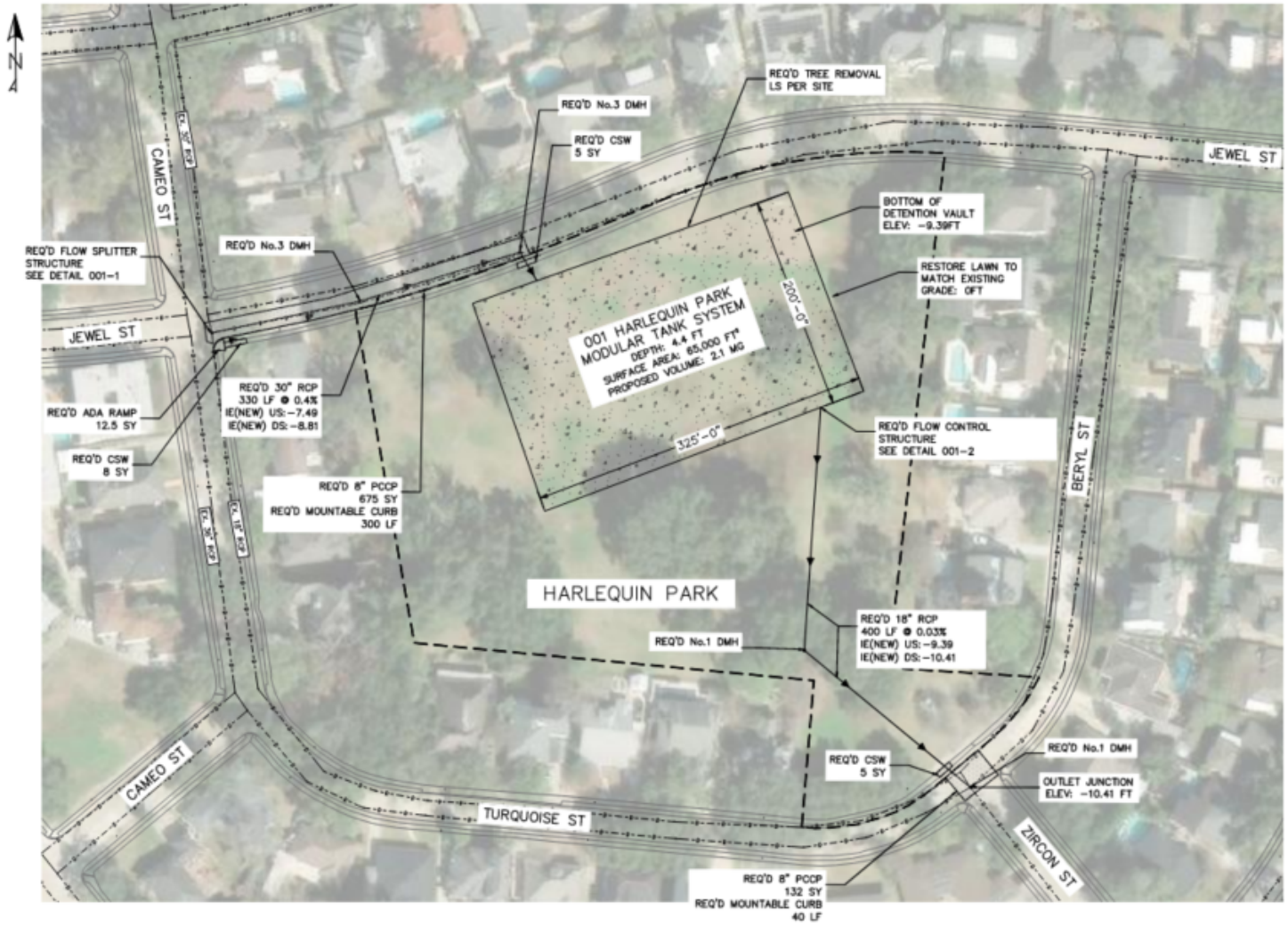
Location Map

Example Photo

(Atlantis, 2018)

Note: Example photo shows a modular tank system; however, subsurface storage can take a variety of forms including underground vaults, chambers, or large pipes or culverts.

Concept 1 Harlequin Park Layout

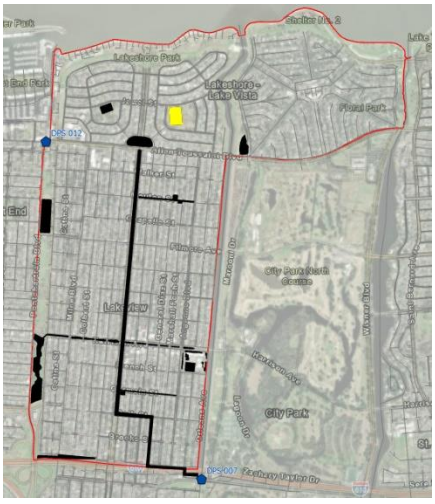


Concept 2 – Tourmaline Park		
Location	Tourmaline Park bounded by Jewel Street (north), Amber Street (west), Turquoise Street (south), and Agate Street (east) in Lakeshore	
BGSI Type	Modular tank system, flow splitter structure, flow control structure	
Solution	Storage volume for runoff from Lakeshore to reduce flow at DPS 12 and DPS 07	
Estimated Soft Cost	$2,170,000 - $4,068,750	
Estimated Construction Cost	$6,200,000 - $11,625,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-4
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	1.2
	Flood Volume Reduced (MGAL)	2.3

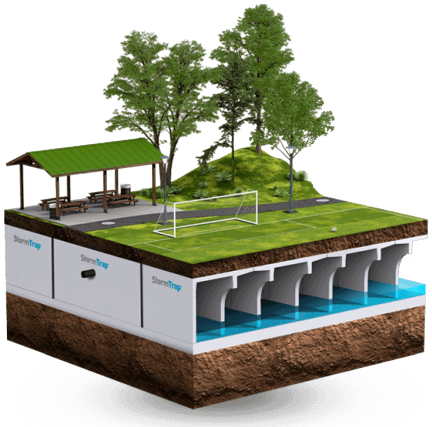
Concept Description

Concept 2, Tourmaline Park, would include approximately 300 feet of new 42-inch-diameter pipe to convey flow from the existing pipe system along Sardonyx Street east toward Amber Street, where water would then be diverted by a flow splitter structure to a new 5.2 MGAL modular tank system within Tourmaline Park. Multiple interconnecting storm lines between Sardonyx Street, Jewel Street, and Amber Street would enhance the benefit of the modular tank system by allowing more water to be captured. The flow splitter along Amber Street would divert water through approximately 100 feet of new 42-inch pipe to the modular tank system and then discharge toward Gem Street and Amber Street via approximately 120 feet of 18-inch-diameter outlet pipe. Outflow from the storage system would be released by an outlet control structure containing an orifice (or active controls) and an overflow weir/riser as the downstream water level recedes. After a storm event, the tank system will slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Location Map



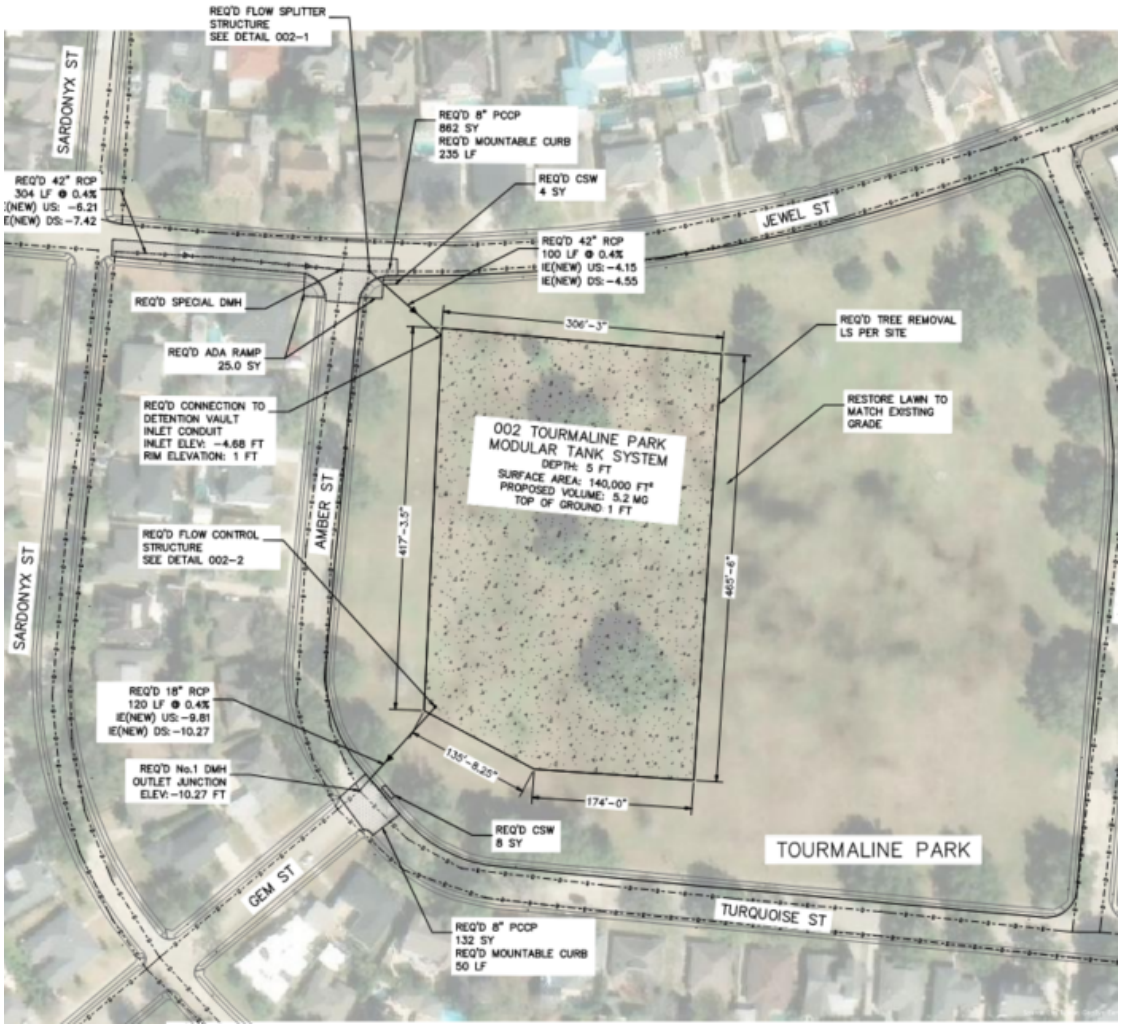
Example Photo



(StormTrap, 2011)

Note: Example photo shows an underground vault system, however, subsurface storage can take a variety of forms including modular tanks, chambers, or large pipes or culverts.

Concept 2 Tourmaline Park Layout



Concept 3A Tiara-Peridot Park - Inline

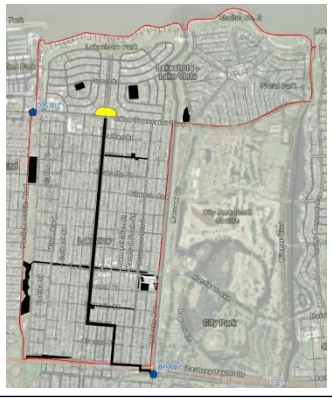
Location	Tourmaline Park bounded by Ring Street (north), Allen Toussaint Blvd. (south), and Canal Blvd. (through the concept) in Lakeshore	
BGSI Type	Inline stormwater park, pipe rerouting, flow spitter structure, flow control structure	
Solution	Storage volume for runoff from Lakeshore to reduce flow at DPS 12 and DPS 07	
Estimated Soft Cost	$4,071,200 - $7,633,500	
Estimated Construction Cost	$11,632,000 - $21,810,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-10
	Avg. WSE Reduction (inches)	-3
	Area of Flood Reduction > 1 Inch (acres)	1
	Flood Volume Reduced (MGAL)	0.2

Concept Description

Concept 3A, Tiara-Peridot Park – Inline, would create a low-flow system both around Tiara-Peridot Park through new 36-inch pipes along Ring Street and through an approximately 7-foot (bottom width) by 2-foot (deep) naturalized urban channel within Tiara-Peridot Park. During high-water events, water would pass through a junction box along the existing box culvert at Ring Street and Canal Street to divert flow into the 5.5 MGAL stormwater park. Flow from the east and west would enter the storage through a weir at Ring Street and Zircon Street (west) and Ring Street and Gem Street (east). The stormwater park would operate as a surcharge pond during high-water events. A flow control structure at the downstream end of the park, including an overflow weir/riser, would allow low flows to pass unrestricted to the downstream system during smaller events and prior to the peak flow. However, the inline orifice would begin the backup flow during higher flows, engaging the storage and reducing downstream flows until the capacity is exceeded and overflow over a weir is allowed to continue downstream. The orifice would then slowly release the stored volume as the downstream water levels recede, thereby returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Through removal and rerouting of existing pipes within Tiara-Peridot Park, as well as removal and rerouting of traffic along Canal Street, maximum capacity can be achieved at this location. A traffic study should be conducted during the further design of this concept to assess optimization of traffic control through Canal Street in coincidence with this design. Possible configurations include restoring the roadway couplet via bridges, reducing to a single roadway/bridge, or diverting all traffic to Ring Street.

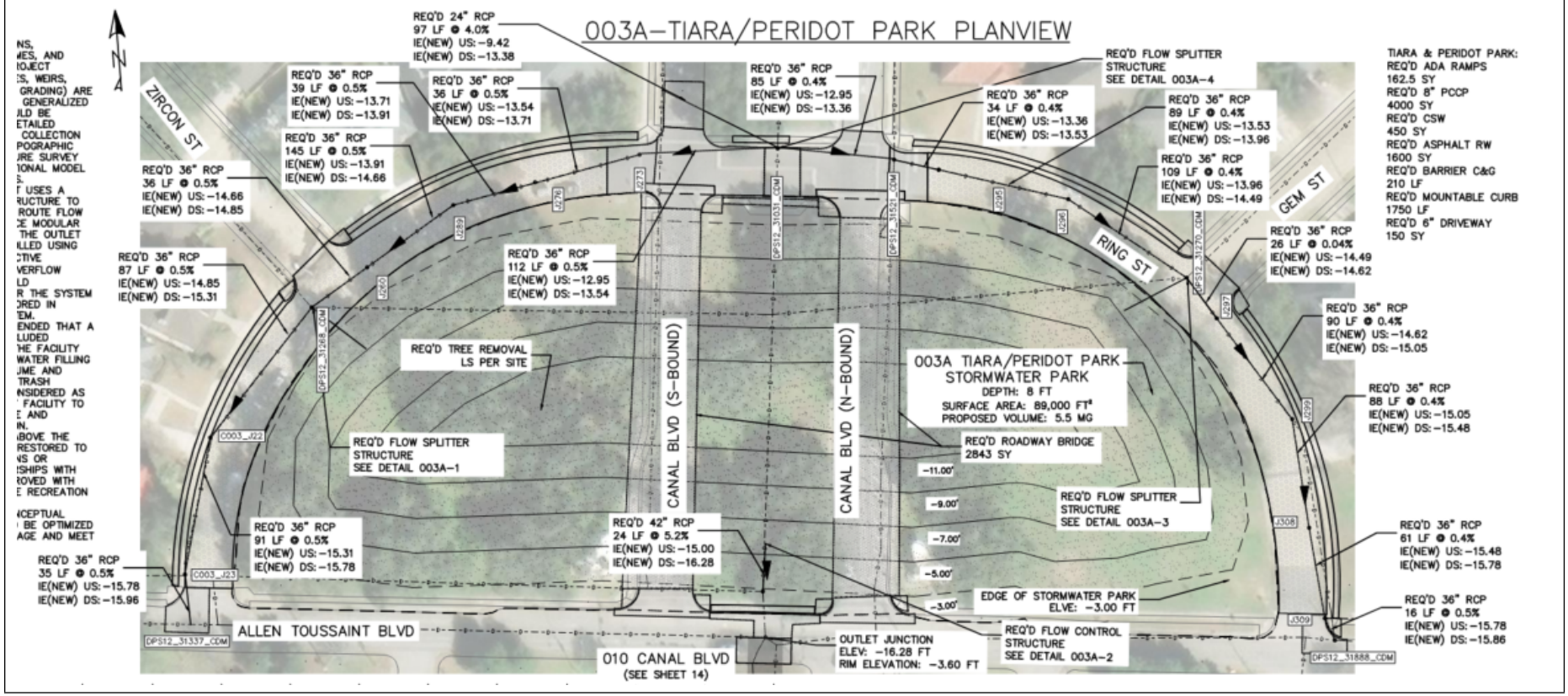
Location Map



Example Photo

(Nola.gov, 2024)

Concept 3A Tiara-Peridot Park – Inline Layout



Concept 3B Tiara-Peridot Park - Offline

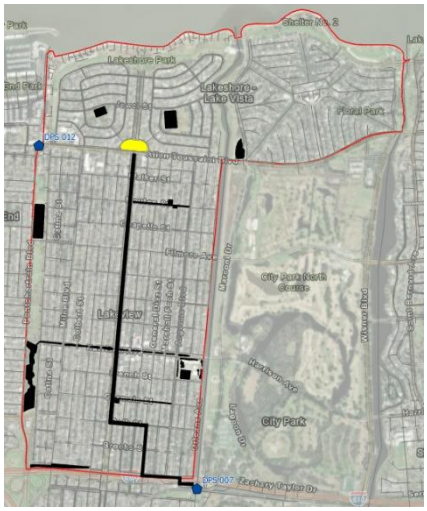
Location	Tourmaline Park bounded by Ring Street (north), Allen Toussaint Blvd. (south), and Canal Blvd. (through the concept) in Lakeshore	
BGSI Type	Offline stormwater park, pipe rerouting, flow spitter structure, flow control structure	
Solution	Storage volume for runoff from Lakeshore to reduce flow at DPS 12 and DPS 07	
Estimated Soft Cost	$865,200 - $1,622,250	
Estimated Construction Cost	$2,472,000 - $4,635,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-3
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	0.6
	Flood Volume Reduced (MGAL)	1.1

Concept Description

Concept 3B would use a flow splitter to divert water from the existing pipe system Ring Street and Zircon Street and the existing pipe system at Ring Street and Gem Street. During high-water events, flow would be diverted through approximately 30 feet of new 30-inch pipes into two separate 2 MGAL stormwater parks on either side of Canal Street. The new storage system would discharge toward Allen Toussaint Blvd. and Canal Street via approximately 75 feet of new 15-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the system downstream water levels recede. After a storm event, the storage system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Through removal and rerouting of existing pipes within Tiara-Peridot Park, greater storage capacity can be achieved at this location. A road diet is considered in this footprint, and a traffic study should be conducted during the further design of this concept to assess impact at Canal Street.

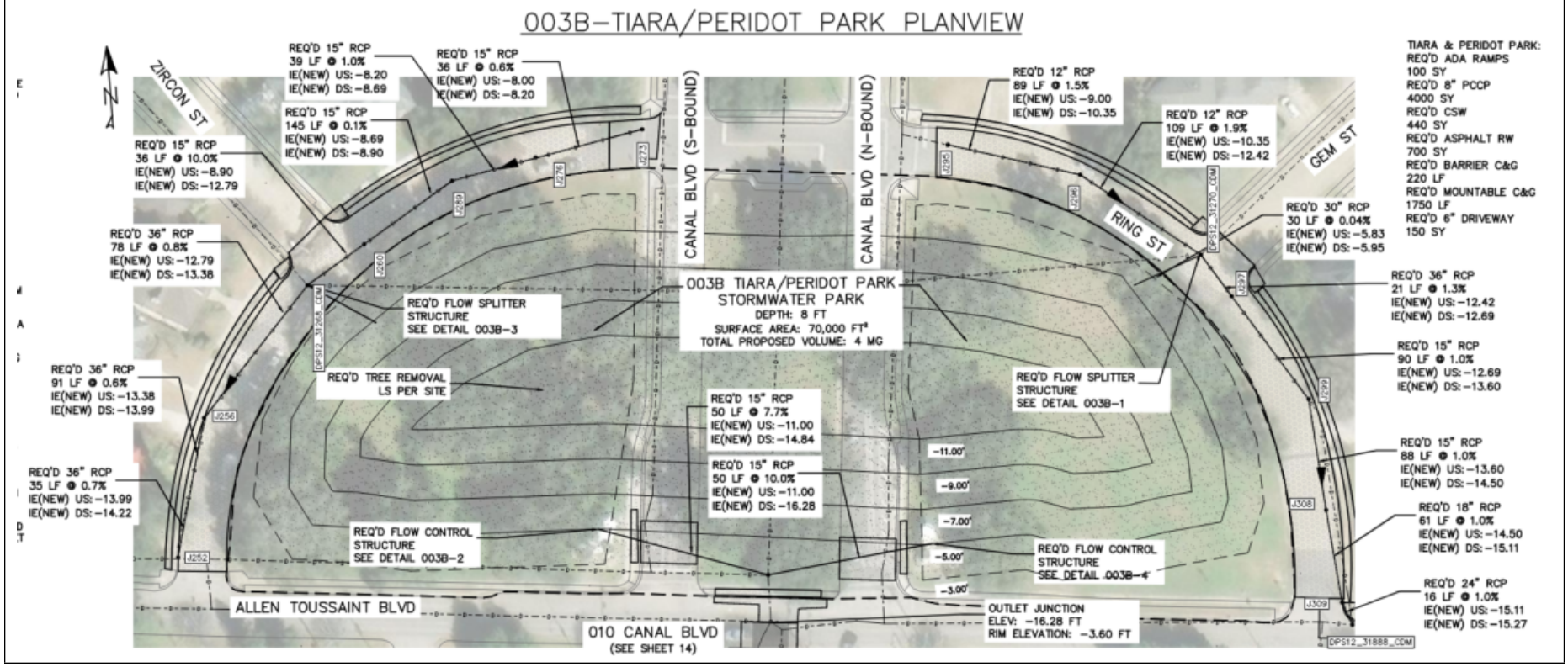
Location Map



Example Photo

(Nola.gov, 2024)

Concept 3B Tiara-Peridot Park – Offline Layout



Note: Contours to be refined during further design

Concept 4 Marconi Levee

Location	Open space near levee along Allen Toussaint Blvd. (south) and Marconi Drive (east) in Lake Vista	
BGSI Type	Stormwater park, flow splitter structure, flow control structure	
Solution	Storage volume for runoff from Lake Vista to reduce flow at DPS12 and DPS07	
Estimated Soft Cost	$375,200 - $703,500	
Estimated Construction Cost	$1,072,000 - $2,010,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-14
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	14.1
	Flood Volume Reduced (MGAL)	1.6

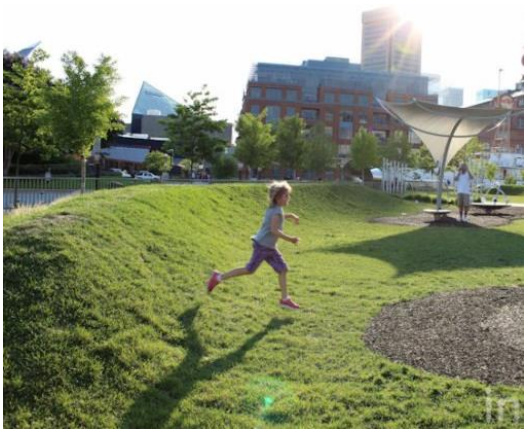
Concept Description

Concept 4, Marconi Levee, would use a flow splitter to divert water from the existing pipe system at Marconi Street and Tulip Lane. During high-water events, flow would be diverted via diversion structure through approximately 50 feet of new 48-inch-diameter pipe into a 3.4 MGAL stormwater park located in the green space east of the Orleans Canal levee. The new storage system discharges toward Allen Toussaint Blvd. and Marconi Street via approximately 70 feet of 48-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater once the downstream system water levels recede. After a storm event, the storage system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Concept 4 is located near a levee, where additional permitting will be required during construction through the United States Army Corps of Engineers and the Southeast Louisiana Flood Protection Authority, at a minimum. Construction limits next to the levee need to be investigated and incorporated during preliminary design.

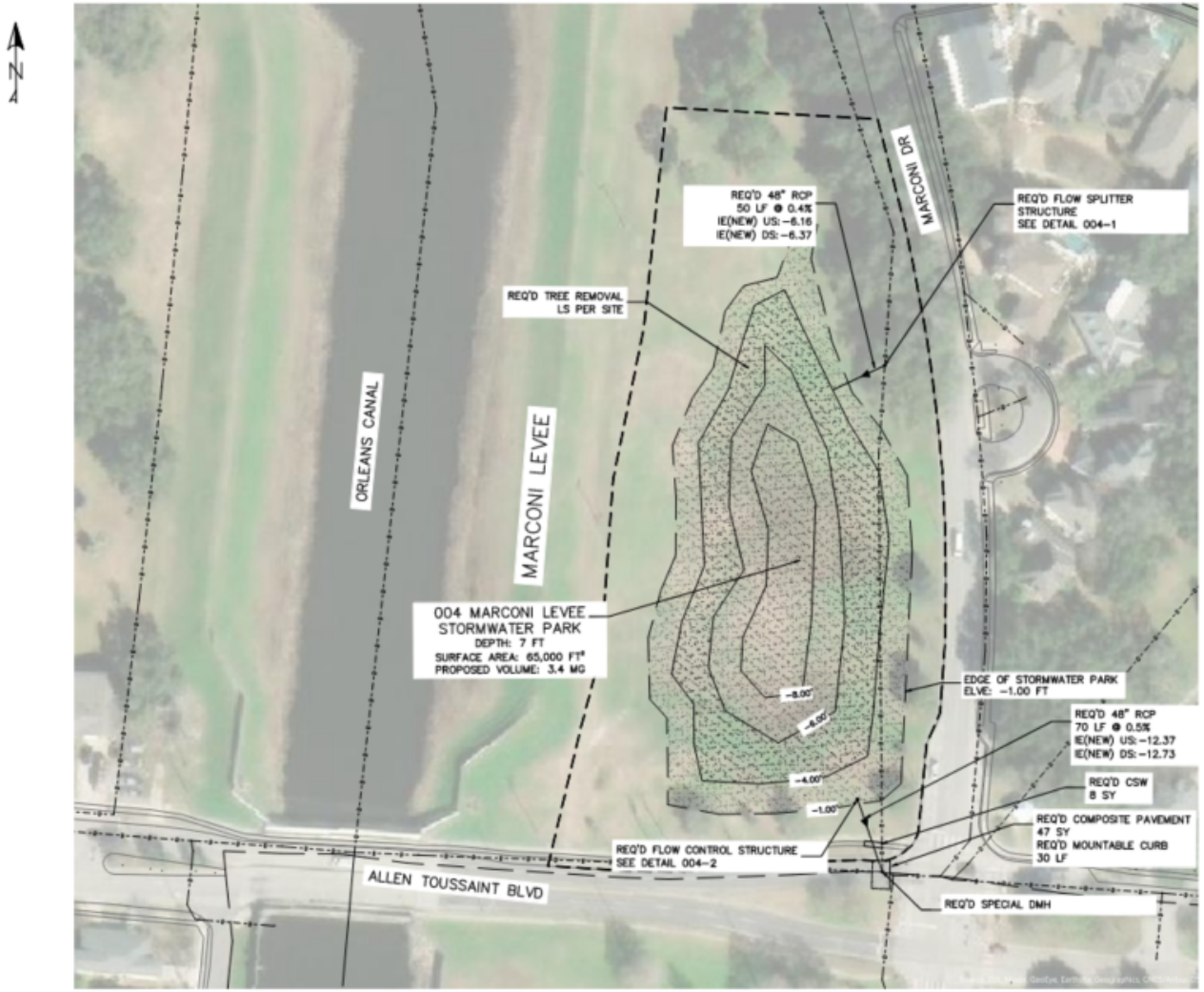
Location Map

Example Photo



(Wang, 2014)

Concept 4 Marconi Levee Layout



Concept 5 Upper West End

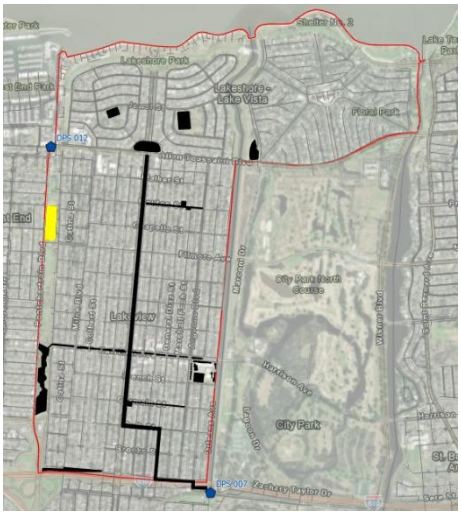
Location	Park space bounded by Pontchartrain Blvd. (west), Fillmore Street (south), and West End Blvd. (east) in Lakeview	
BGSI Type	Stormwater park, flow splitter structure, flow control structure	
Solution	Blue-green storage volume in Lakeview to reduce flow at DPS 12	
Estimated Soft Cost	$1,251,600 - $2,346,750	
Estimated Construction Cost	$3,576,000 - $6,705,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-6
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	0.7
	Flood Volume Reduced (MGAL)	2.0

Concept Description

Concept 5, Upper West End, would use a flow splitter to divert water from the existing pipe system at West End Blvd. at the manhole 255 feet north of Filmore Avenue. During high-water events, flow would be directed through approximately 80 feet of new 36-inch-diameter pipe into an 8.9 MGAL stormwater park located in the green space between Pontchartrain Street and West End Blvd. The new storage system discharges toward West End Blvd. and Downs Street via approximately 80 feet of 12-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater once the downstream system water levels recede. After a storm event, the storage system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Concept 5 is located within the West End green space, which has a long history of development and as such possibly contains the human remains of those who perished during the original construction of the canal. There is a burial memorial in remembrance of those lost during this construction located to the north of this concept location. It is possible that remediation will be required if additional remains are found during construction, and the need to be respectful during construction of the memorial is pertinent.

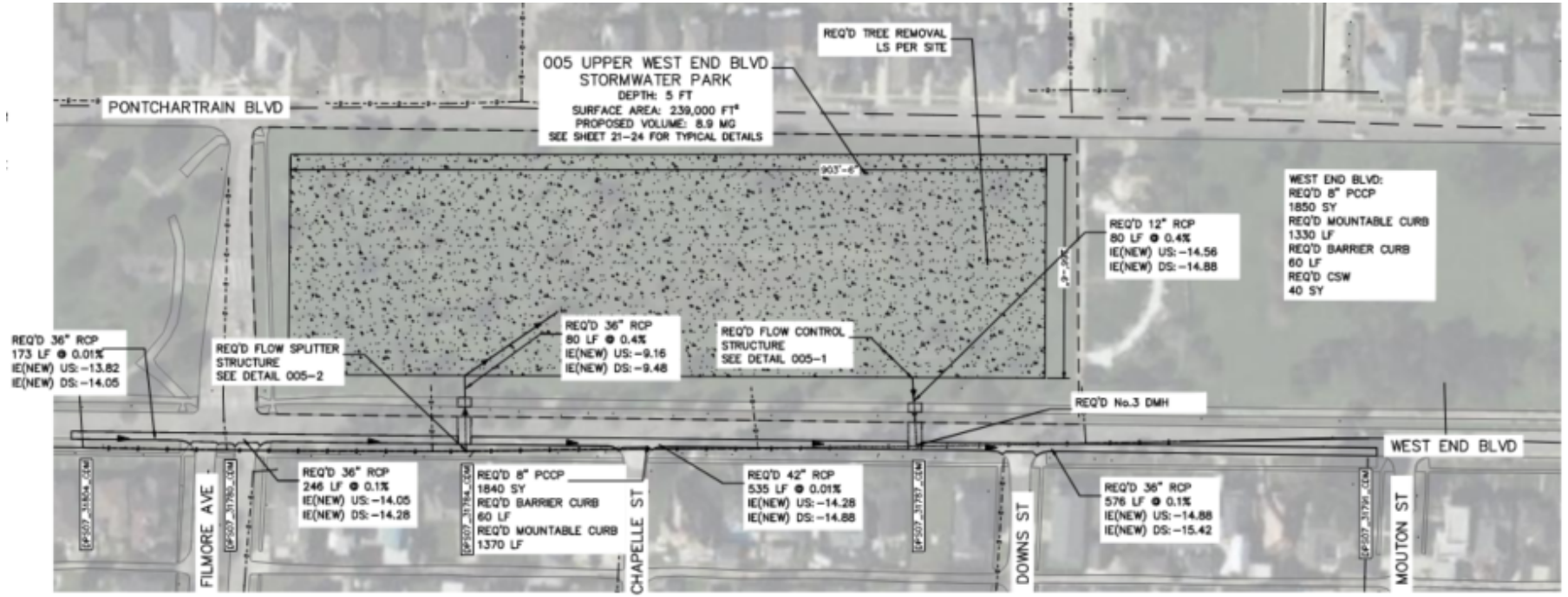
Location Map



Example Photo

(Nola.gov, 2024)

Concept 5: Upper West End



Note: Contours to be refined in further design analysis

Concept 6 Mouton Street		
Location	Mouton Street from Canal Blvd. (west) to Argonne Blvd. (east) in Lakeview	
BGSI Type	Modular storage tank, conveyance upgrades	
Solution	Localized conveyance improvements to store flow locally offline during the peak of the event	
Estimated Soft Cost	$1,270,800 - $2,382,750	
Estimated Construction Cost	$2,376,000 - $4,455,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-3
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	0.3
	Flood Volume Reduced (MGAL)	1.0

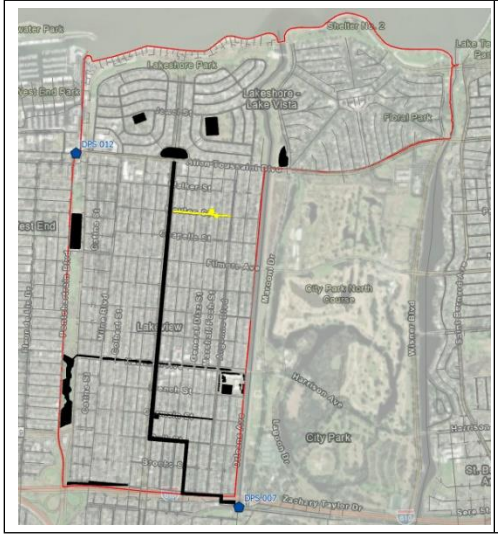
Concept Description

Concept 6, Mouton Street, would upgrade the conveyance system along Mouton Street from Argonne Blvd. to Memphis Street, directing flow through new 24-inch pipes toward Canal Street. Mouton Street pipes will be disconnected at Argonne Blvd. The slope of the pipe network would be reversed from Argonne Blvd. to Marshall Foch Street to flow toward Canal Blvd. through approximately 320 feet of new 24-inch pipe. Approximately 290 feet of new 24-inch pipe would be added from Marshall Foch Street to General Diaz Street. These upgrades would tie into the existing 24-inch pipe at Memphis Street that was recently updated through Joint Infrastructure Recovery Request (JIRR) projects.

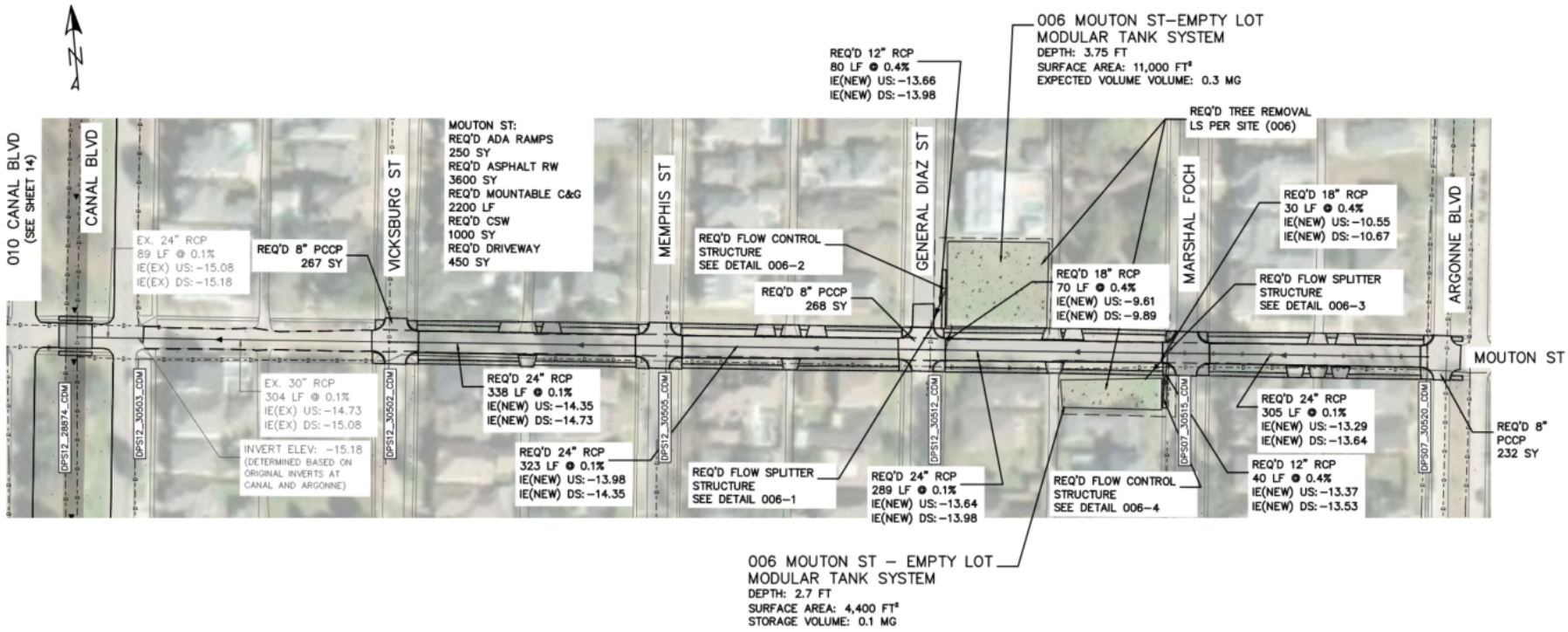
Concept 6 would also use a flow splitter to divert water from the existing system at Mouton Street and Marshall Foch Street and the existing system at Mouton Street and General Diaz Street. During high-water events, flow would be diverted through approximately 30 feet of new 18-inch pipe into a 0.1 MGAL subsurface modular tank system at an open lot at 878 Mouton Street and approximately 70 feet of new 18-inch pipe into a 0.3 MGAL subsurface modular tank system at 6901 General Diaz Street. The new storage system would discharge toward Mouton Street via approximately 40 feet of 12-inch outlet pipe at Marshall Foch Street and 80 feet of 12-inch pipe at General Diaz Street. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the downstream water levels recede. After a storm event, the tank system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Concept 6 storage is located at 3 privately owned properties is required with land acquisition is approximated at $183,000 per parcel based on the 2025 City of New Orleans Assessor Record. Concurrent to the development of these properties for stormwater use is the potential to achieve multiple benefits for the community by co-creating public open park space in the form of pocket parks.

Concept 6 Mouton Street

Location Map	Example Photo
	*(StormTrap, 2023)*

Concept 6 Mouton Street Layout



Concept 7 Harrison Avenue

Location	Harrison Avenue from West End Blvd. (west) to Argonne Blvd. (east) in Lakeview	
BGSI Type	Conveyance upgrades, permeable pavement, sunken gardens	
Solution	Improvements to major conveyance system to create subsurface storage and mitigate backwater conditions in the system	
Estimated Soft Cost	$2,842,000 - $5,328,750	
Estimated Construction Cost	$8,120,000 - $15,225,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-6
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	2.2
	Flood Volume Reduced (MGAL)	2.7

Concept Description

Concept 7, Harrison Avenue, would upgrade the box culvert along Harrison Avenue. The project includes two main components:
Harrison Avenue West (Milne Blvd. to Canal Street):

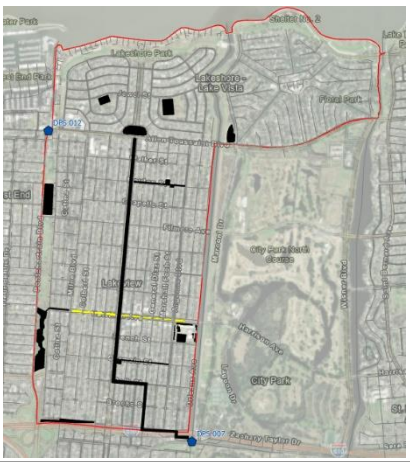
- Upgrade to a 6-foot-high by 6.5-foot-wide box culvert under the neutral ground along Harrison Avenue (Further refinement of final box culvert size may need to be refined in further design phases.)
- Incorporation of a sunken garden concept above the box culvert to enhance the aesthetic and functional value of the area

Harrison Avenue East (Argonne Blvd. to Canal Street):

- Upgrade to a 6-foot-high by 6.5-foot-wide box culvert under the neutral ground along Harrison Avenue (Further refinement of final box culvert size may need to be refined in further design phases.)
- Implementation of permeable pavement within the neutral ground to be used for parking, facilitating additional water infiltration and storage

Given that this is a high-traffic area, careful consideration of traffic management and a traffic study will be essential during further design phases of this project concept.

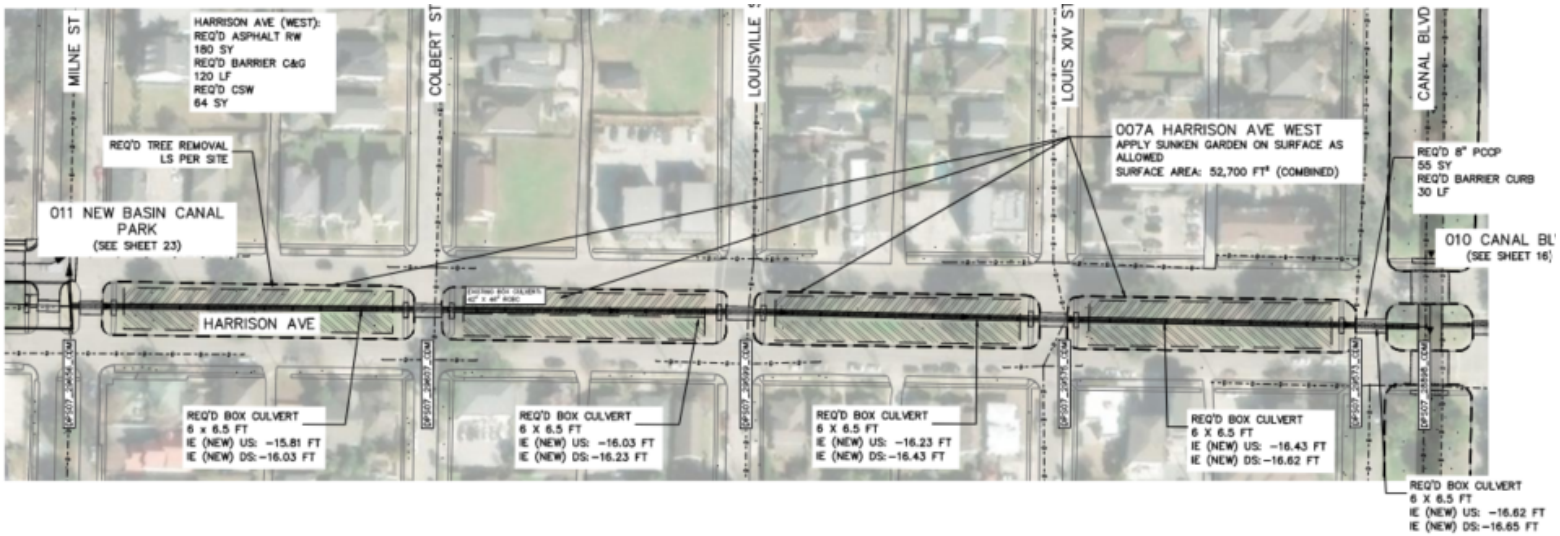
Location Map

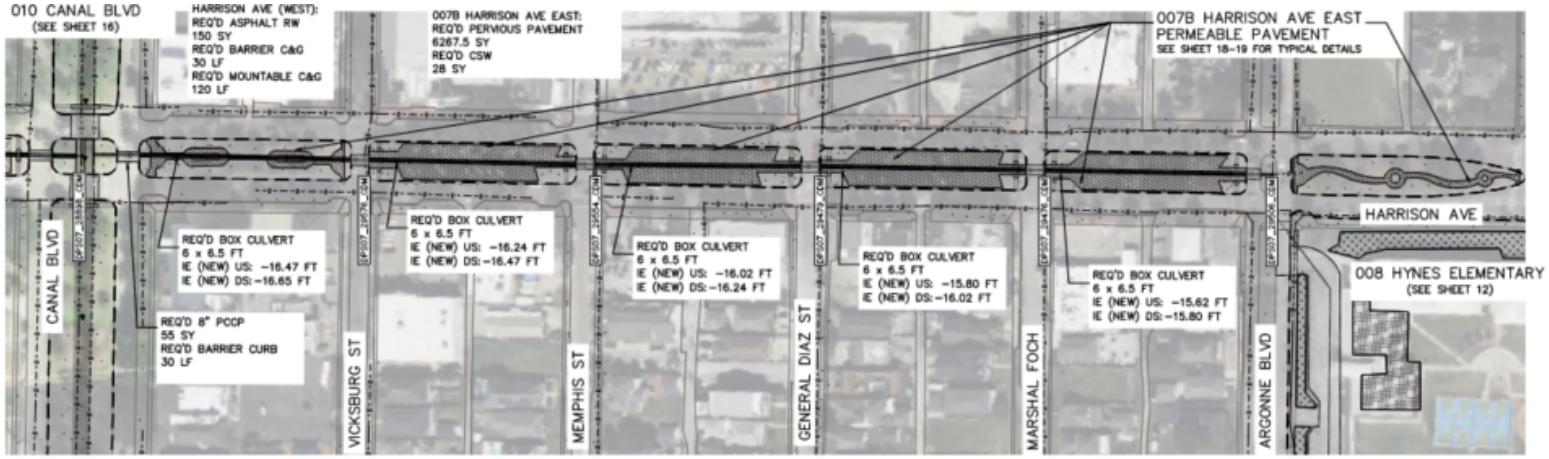


Example Photo

(BRW, 2012)

Concept 7 Harrison Street Layout





Concept 8 Hynes Elementary		
Location	Hynes Elementary bounded by Harrison Street (north), Argonne Blvd. (west), French Street (south), and Orleans Avenue (east) in Lakeview	
BGSI Type	Modular tank system, green roof, bioswales	
Solution	Blue-green storage volume in Lakeview to reduce flow at DPS 07	
Estimated Soft Cost	$1,853,600 - $3,475,500	
Estimated Construction Cost	$5,296,000 - $9,930,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-2
	Avg. WSE Reduction (inches)	-2
	Area of Flood Reduction > 1 Inch (acres)	0.2
	Flood Volume Reduced (MGAL)	0.8

Concept Description

Concept 8, Hynes Elementary, would use a flow splitter to divert water from the existing pipe system at Harrison Avenue and Argonne Blvd. During high-water events, flow would be diverted via a diversion structure through approximately 450 feet of new 36-inch-diameter pipe along Argonne Blvd. and the school parking lot into a 2.7 MGAL subsurface modular storage system under the soccer field at Edward Hynes Elementary School. The new storage system would discharge toward French Street and Argonne Blvd. via approximately 140 feet of 24-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the downstream water levels recede. After a storm event, the tank system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit. Additionally, the green spaces surrounding Hynes Elementary could be utilized as bioswales with a combined proposed volume of approximately 1.0 MGAL, including the following:

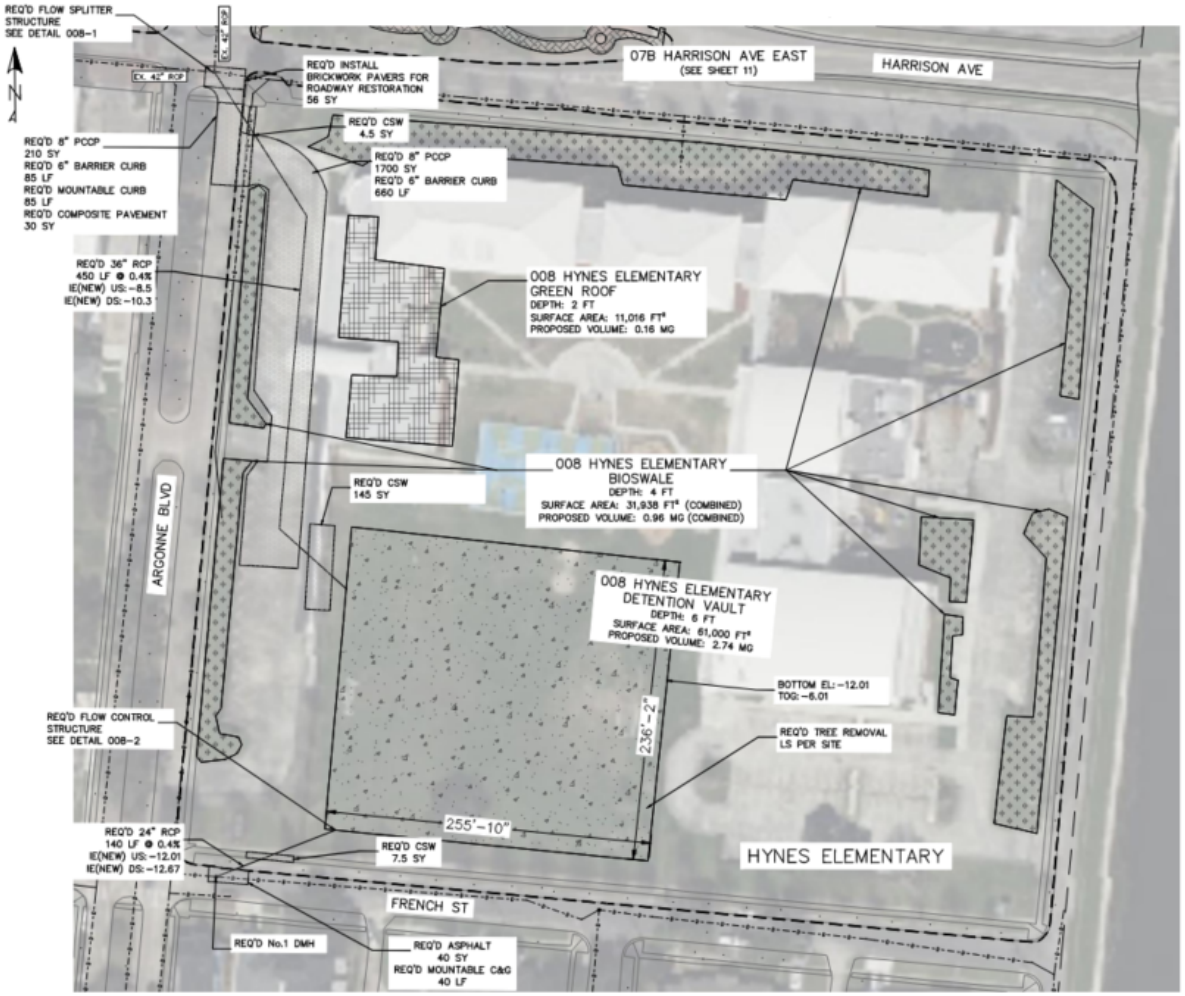
- Two green spaces on Argonne Blvd.
- One green space along Harrison Avenue on the south side
- Two green spaces along Orleans Avenue
- One green space directly in front of the main campus building

A 1.6 MGAL green roof would be located on the northwest building of Hynes Elementary. This would necessitate retrofitting the existing structure and conducting a structural analysis to assess the impact of the additional weight. Due to the location at an elementary school, construction activities would need to be coordinated with the school administration to minimize disruption during school hours. This concept also presents a valuable opportunity for collaboration with the school, although discussions have not been initiated as of December 2024.

Concept 8 Hynes Elementary

Location Map	Example Photo
	(MMSD, 2017)

Concept 8: Hynes Elementary



Concept 9 Germain Street		
Location	Germain Street from Canal Blvd. (west) to Argonne Blvd. (east) in Lakeview	
BGSI Type	Modular storage tank, conveyance upgrades, flow splitter structure, flow control structure	
Solution	Localized conveyance improvements to store flow locally offline during the peak of the event	
Estimated Soft Cost	$942,400 - $1,767,000	
Estimated Construction Cost	$1,856,000 - $3,480,000	
Hydraulic Benefits	Max WSE Reduction (inches)	**-2**
	Avg. WSE Reduction (inches)	**-2**
	Area of Flood Reduction > 1 Inch (acres)	0.0
	Flood Volume Reduced (MGAL)	0.7

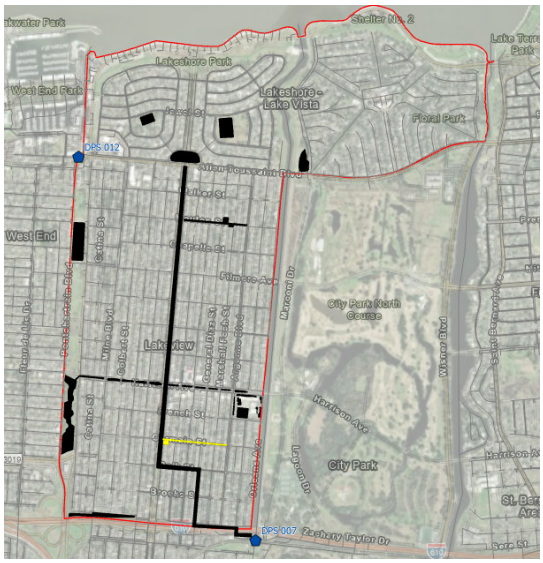
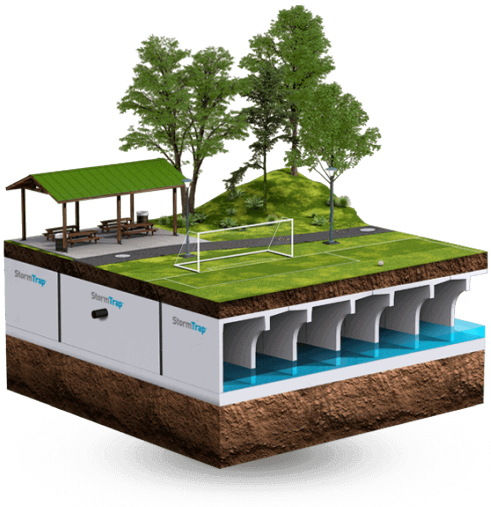
Concept Description

Concept 9, Germain Street, would upgrade the conveyance system along Germain Street from Argonne Blvd. to Canal Street. The project would direct flow through new 36-inch pipes toward Canal Street. The existing pipes on Germain Street would be disconnected at Argonne Blvd., and the slope of the pipe network would be reversed from Argonne Blvd. to General Diaz Street, allowing flow toward Canal Blvd. through approximately 640 feet of 36-inch pipe. These upgrades will connect to an additional 925 feet of 36-inch pipe extending from General Diaz Street to Canal Street.

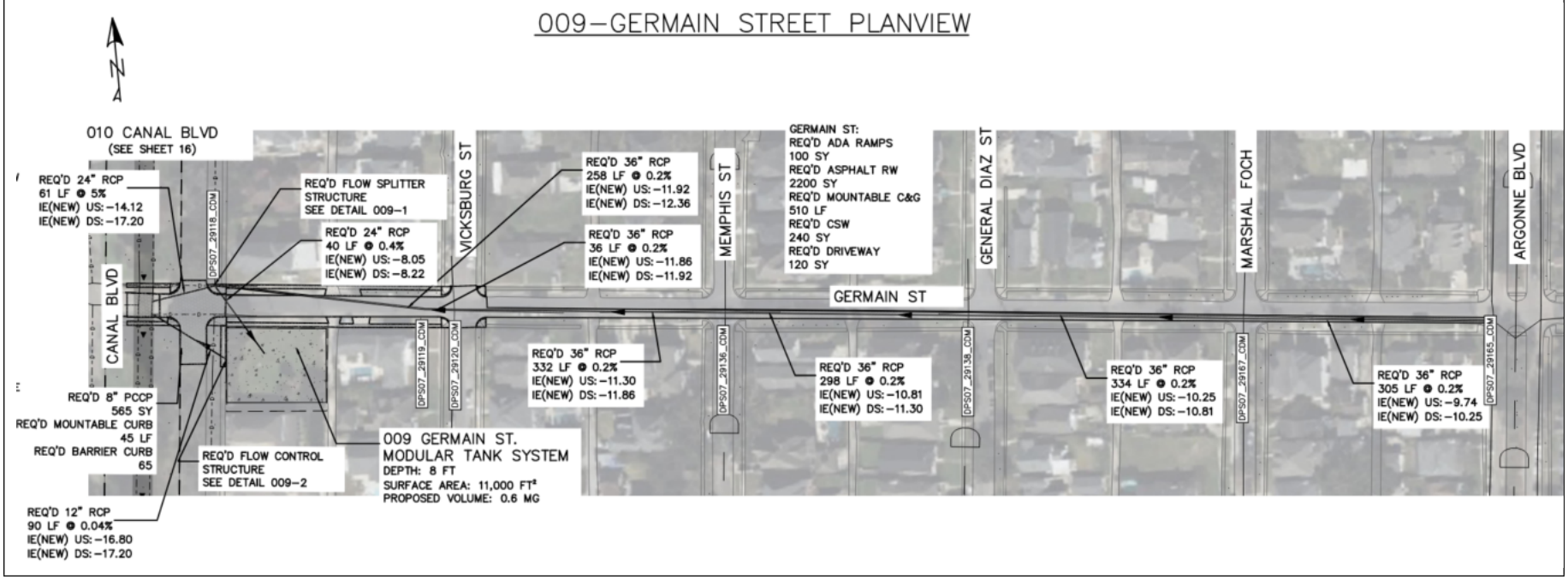
Concept 9 would use a flow splitter to divert water from the existing pipe system at Germain Street and Canal Blvd. During high-water events, flow would be diverted through approximately 40 feet of new 24-inch-diameter pipe along Germain Street into a 0.6 MGAL subsurface modular storage system in the empty lots at the corner of Canal Blvd. and Germain Street. The new storage system would discharge toward Canal Blvd. via approximately 90 feet of 12-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the downstream water levels recede. After a storm event, the tank system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Concept 9 storage is located at 2 privately owned properties is required, and land acquisition is approximated at $183,000 per parcel by 2025 City of New Orleans Assessor Record. to the development of these properties for stormwater use is the potential to achieve multiple benefits for the community by co-creating public open park space in the form of pocket parks.

Concept 9 Germain Street

Location Map	Example Photo
	 *(StormTrap, 2011)*

Concept 9 Germain Street Layout



Concept 10 Canal Blvd.		
Location	Canal Blvd. from Allen Toussaint Blvd. to DPS 07 in Lakeview	
BGSI Type	Open box culvert, upsize box culvert	
Solution	Improvements to major conveyance system to create subsurface storage and mitigate backwater conditions in the system	
Estimated Soft Cost	$17,071,600 - $32,009,250	
Estimated Construction Cost	$48,776,000 - $91,455,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-9
	Avg. WSE Reduction (inches)	-1
	Area of Flood Reduction > 1 Inch (acres)	24.5
	Flood Volume Reduced (MGAL)	0.4

Concept Description

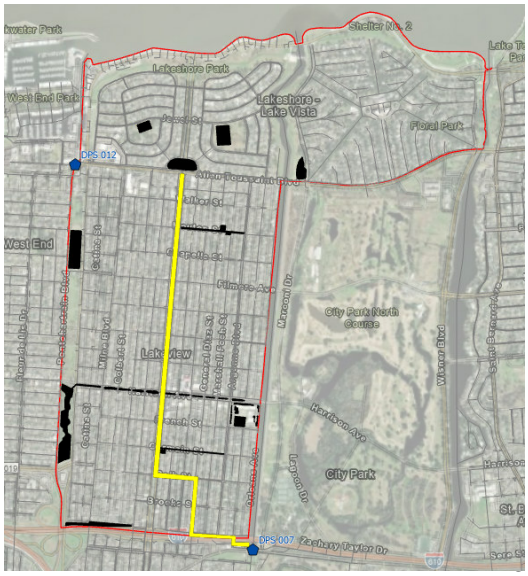
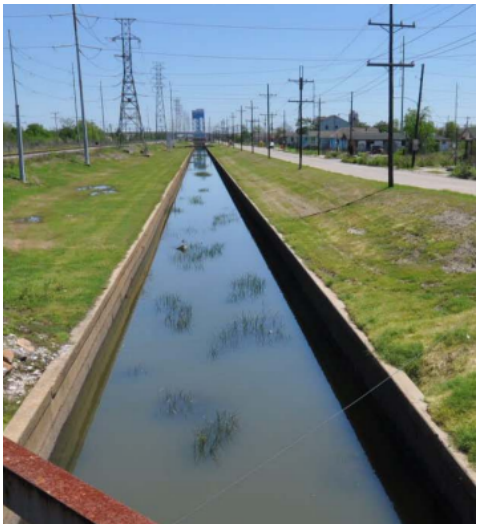
Concept 10, Canal Blvd., would construct a concrete lined open box culvert along Canal Street to serve as the backbone of the Lakeview system to DPS 07. Concept 10 was similar to canal improvement suggestions from the Urban Water Plan (Waggonner and Ball, 2013). From Allen Toussaint Blvd. to Polk Street, the box culvert would be open like the Metairie Relief Canal from Central City to DPS 06 The open box culvert would span 6,800 feet, measure 9 feet high by 25 feet wide, and provide space along each side for safety and beautification measures. Additionally, the Canal Street box culvert would be upsized to 9 feet high and 25 feet wide from Polk Street to DPS 07 described as follows:

- Approximately 1,080 feet from Polk Street to General Diaz Street
- Approximately 1,350 feet from General Diaz Street to Kenilworth Street
- Approximately 1,070 feet from Kenilworth Street under I-10 to General Haig Street
- Approximately 290 feet from General Haig Street to the DPS 07 along the north side of the railroad
- Approximately 510 feet to DPS 07

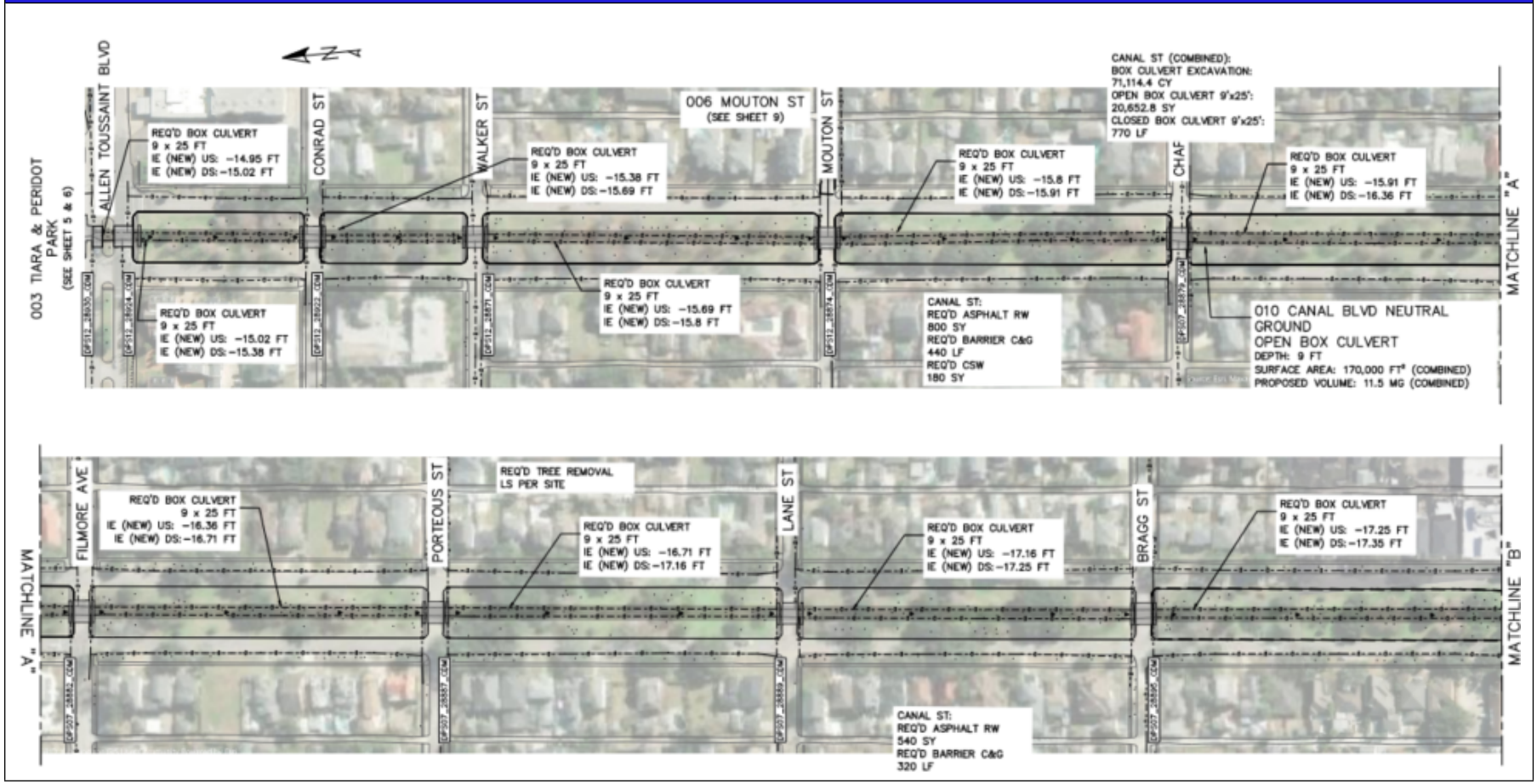
The feasibility of this project is challenged by its high cost and the significant traffic disruptions expected during construction in such a high-traffic area. A traffic analysis would be required to manage disruptions, provide safety during construction, and determine the need for bridges or roadways above cross streets. Additionally, the project must address potential impacts and the complexity of coordinating with existing infrastructure and utilities. An alternate configuration involves increasing the size of the underground box culvert while implementing sunken gardens above, enhancing both the functionality and aesthetics of the area.

Costs do not include that the system may require pile supports which would further increase cost.

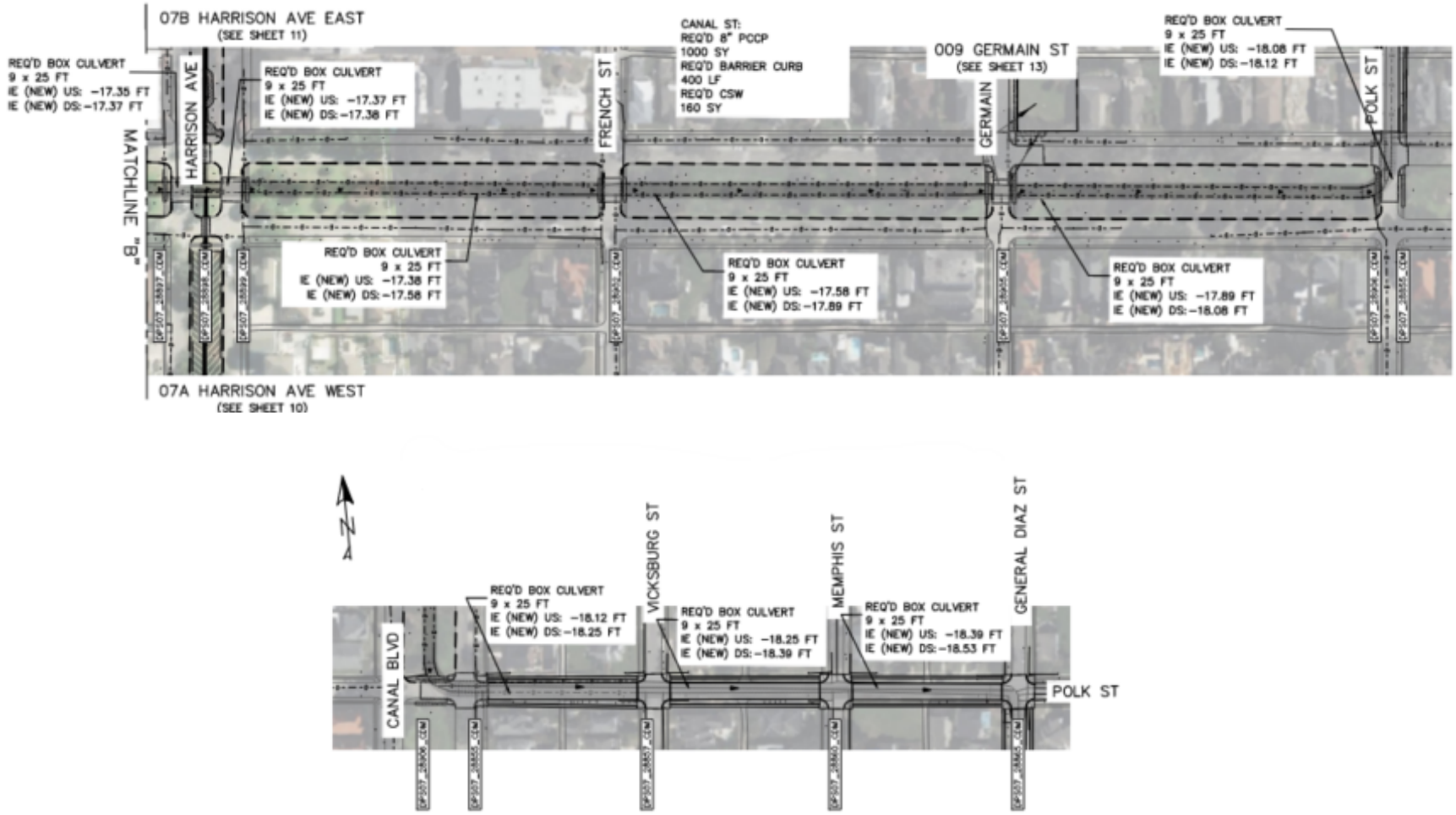
Concept 10 Canal Blvd.

Location Map	Open Box Culvert Example
	 *(Urban Water Plan, 2013))*

Concept 10 Canal Street Layout



Concept 10 Canal Street Layout



Concept 11 New Basin Canal Park

Location	New Basin Canal Park bounded by Harrison Avenue (north), Pontchartrain Blvd. (west), Veterans Blvd. (south), and West End Blvd. (east) in Lakeview	
BGSI Type	Stormwater park, conveyance upgrades, flow control structure	
Solution	Blue-green storage volume in Lakeview to reduce flow at DPS 12 and DPS 07	
Estimated Soft Cost	$1,990,800 - $3,732,750	
Estimated Construction Cost	$5,688,000 - $10,665,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-6
	Avg. WSE Reduction (inches)	-1
	Area of Flood Reduction > 1 Inch (acres)	37.5
	Flood Volume Reduced (MGAL)	4.9

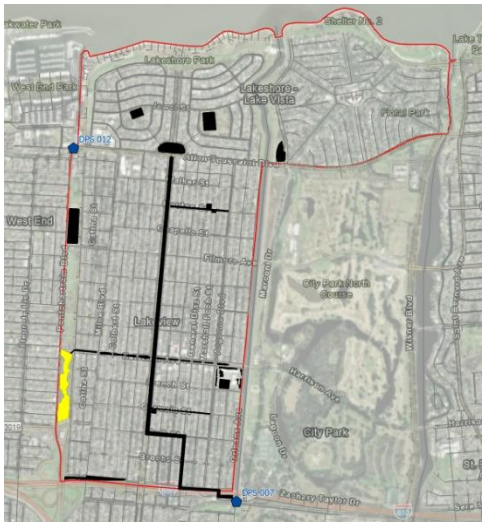
Concept Description

Concept 11, New Basin Canal Park, would use a flow control structure at West End Blvd. and Harrison Avenue via approximately 635 feet of new 42-inch pipe that would convey low flow toward Milne Blvd. When the 42-inch pipe below the Harrison Avenue neutral ground surcharges, the excess flow will be diverted into the 17 MGAL stormwater park at the New Basin Canal via 130 feet of 42-inch equalizing pipe.

Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the downstream water levels recede. After a storm event, the storage system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

Concept 11 is located within the West End green space, which has a long history of development and as such possibly contains the human remains of those who perished during the original construction of the canal. There is a burial memorial in remembrance of those lost during this construction located to the north of this concept location. It is possible that remediation will be required if additional remains are found during construction, and the need to be respectful during construction of the memorial is pertinent.

Location Map



Example Photo

(Brentwood Bound, 2024)

Concept 11 New Basin Canal Layout

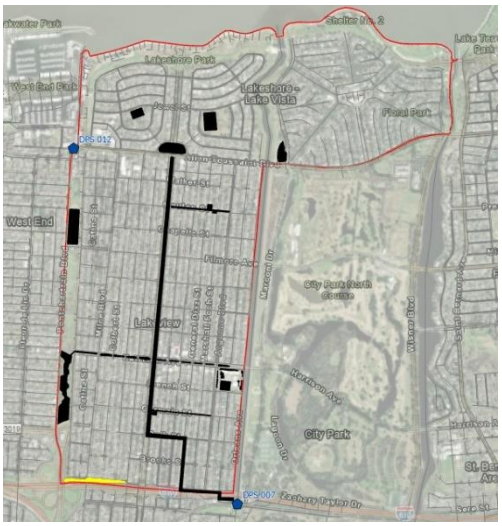
Concept 12 Kenilworth Street

Location	ROW south of Kenilworth Street from West End Blvd. (west) to Canal Blvd. (east) in Lakeview	
BGSI Type	Stormwater park, flow splitter/control structure	
Solution	Blue-green storage volume in Lakeview to reduce flow at DPS 07	
Estimated Soft Cost	$557,200 - $1,044,750	
Estimated Construction Cost	$1,592,000 - $2,985,000	
Hydraulic Benefits	Max WSE Reduction (inches)	-18
	Avg. WSE Reduction (inches)	-4
	Area of Flood Reduction > 1 Inch (acres)	5.8
	Flood Volume Reduced (MGAL)	2.2

Concept Description

Concept 12, Kenilworth Street., would use a flow splitter to divert water from the existing pipe system along Kenilworth Street and Milne Blvd. During high water events, flow would be directed through approximately 10 feet of new 12-inch-diameter pipe into a 6.3 MGAL stormwater park located in the green space at Kenilworth Street and I-10. The new storage system would discharge toward Colbert Street and Kenilworth Street via approximately 10 feet of 12-inch-diameter outlet pipe. Outflow from the storage system would be controlled using an orifice (or active controls) and an overflow weir/riser to release stormwater after the downstream water levels recede. After a storm event, the storage system would slowly drain, returning the available storage volume to the system. A flap gate downstream of the facility may be required to prevent backwater from filling the storage volume too early during a storm event and thereby diminishing its benefit.

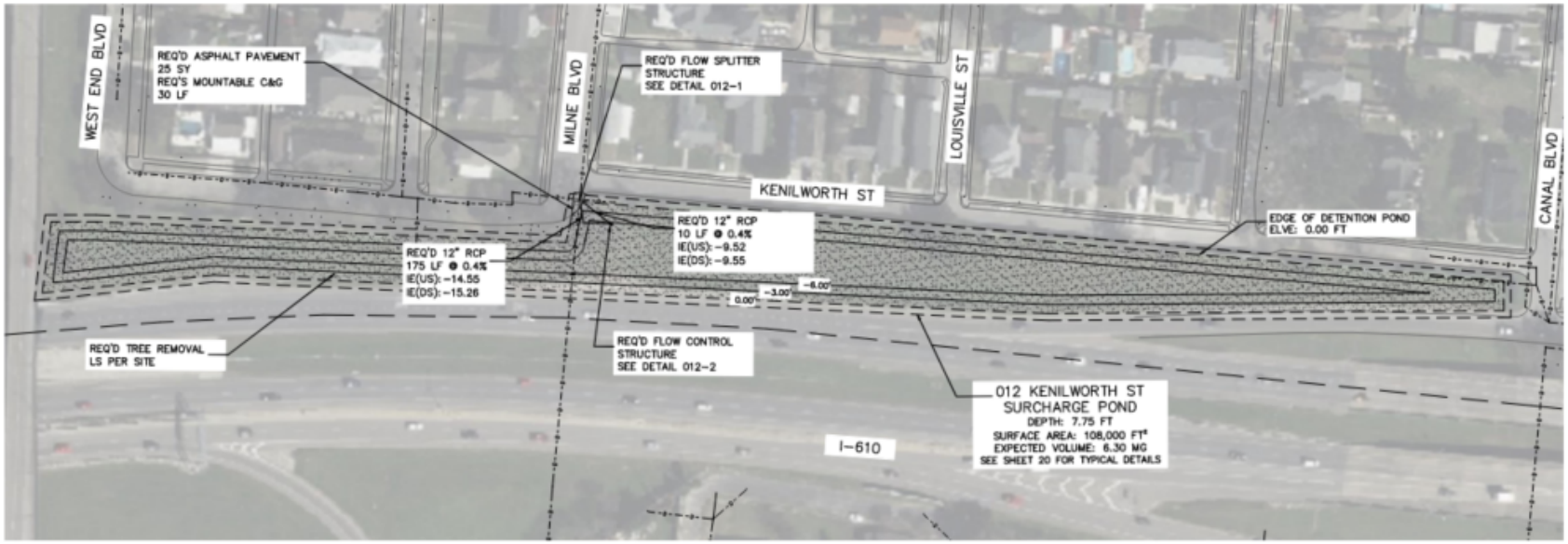
Location Map



Example Photo

(MMSD, 2017)

Concept 12: Kenilworth Street



6.2 Cost Estimates

Class 4 estimates were prepared to establish an Engineer's opinion of probable construction cost based on the 10% level of design. Class 4 cost estimates are prepared for a variety of purposes including detailed strategic planning, business development, project screening, alternatives analysis, confirmation of economic feasibility, budget planning, and preliminary budget approvals. Class 4 estimates are considered budget estimates with an expected accuracy range of -15% to -30% on the low end and +20% to +50% on the high end. The estimates were prepared using a combination of stochastic and deterministic methods.

The cost of the BGSI components were estimated stochastically using statistical relationships derived from previous studies, such as those that relate storage volume to overall construction costs. Various tools and references were used for this purpose include the integrated decision support tool (iDST), a life cycle costing module for distributed BGSI developed by the Colorado School of Mines in collaboration with researchers at UC Berkeley, the South Dakota School of Mines, Georgia Tech, and The Nature Conservancy (https://idst.mines.edu/lca-lcca/). The iDST is an Excel workbook that allows for planning-level evaluation of costs and first-order environmental impacts of stormwater infrastructure. It employs unit process inventories and default values for various stormwater control measures, adjusting costs based on location with the RSMeans Base City Cost Index. This tool draws from multiple cost components, including material, labor, and equipment, and multiplies these by the cost per unit input for each component. It also incorporates net present value (NPV) calculations, accounting for cost escalation that varies by cost type (http://hdl.handle.net/1853/62873).

The values generated by the iDST were verified against those produced by the EPA-sponsored Community-enabled Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC) tool, developed by the Water Research Foundation in collaboration with Colorado State University and the One Water Solutions Institute (https://www.waterrf.org/CLASIC). The CLASIC tool compares life cycle costs of stormwater infrastructure practices under different scenarios. Additionally, the International Stormwater Best Management Practices Database (BMPDB) was referenced to confirm accuracy and consistency. The BMPDB is a repository of BMP field studies and monitoring guidance (https://bmpdatabase.org/).

These tools were used to develop power relationship functions for different BGSI types and sizes as represented by storage volumes. Additional line items, such as conveyance improvements, sidewalk improvements, and other related enhancements, were estimated using a standard line-item approach based on historical pricing for CNO Department of Public Works projects. This method involves breaking down each component of the project into individual items and estimating the cost of each separately, ensuring a comprehensive and detailed cost analysis.

Soft cost were initially quantified utilizing Louisiana Facility Planning and Control (FPC) fee curves, resulting in an estimation of approximately 8%. However, this figure was deemed insufficient when benchmarked against historical regional project data. In recognition of the project's inherent complexity, the soft costs were estimated at 35% of the construction cost based on data provided of recently developed projects. BSIA summary of the cost estimates for each project are provided in Table 6-1 with detailed cost estimates provided in Appendix G.

Table 6-1. Concept Cost Estimate Summary

ID	Concept	Soft Cost	Construction	Total Cost	Total Low-cost Range (-20%)	Total High-cost Range (+50%)
1	Harlequin Park	$1,340,500	$3,830,000	$5,170,000	$4,136,000	$7,755,000
2	Tourmaline Park	$2,712,500	$7,750,000	$10,460,000	$8,368,000	$15,690,000
3A	Tiara and Peridot Park - Inline	$5,089,000	$14,540,000	$19,630,000	$15,704,000	$29,445,000
3B	Tiara and Peridot Park - Offline	$1,081,500	$3,090,000	$4,170,000	$3,336,000	$6,255,000
4	Marconi Levee	$469,000	$1,340,000	$1,810,000	$1,448,000	$2,715,000
5	Upper West End	$1,564,500	$4,470,000	$6,030,000	$4,824,000	$9,045,000
6	Mouton Street	$1,588,500	$2,970,000	$4,560,000	$3,648,000	$6,840,000
7	Harrison Avenue	$3,552,500	$10,150,000	$13,700,000	$10,960,000	$20,550,000
8	Hynes Elementary School	$2,317,000	$6,620,000	$8,940,000	$7,152,000	$13,410,000
9	Germain Street	$1,178,000	$2,320,000	$3,500,000	$2,800,000	$5,250,000
10	Canal Blvd.	$21,339,500	$60,970,000	$82,310,000	$65,848,000	$123,465,000
11	New Basin Canal	$2,488,500	$7,110,000	$9,600,000	$7,680,000	$14,400,000
12	Kenilworth Street	$696,500	$1,990,000	$2,690,000	$2,152,000	$4,035,000
13	Combined	$45,417,500	$127,150,000	$172,570,000	$138,056,000	$258,855,000

Note: Cost range based on Class 4 cost estimate of -20% to +50%.

Soft costs are estimated 35% of construction cost and are meant to include expenses such as architectural and design fees, permits and legal fees, insurance, financing costs, project management fees, consultancy fees, public engagement, and administrative costs.

6.3 Future Design Considerations

Numerous considerations must be addressed to help guide the projects to success during detailed design, including:

- **Locations of Trees: Information regarding existing trees is in Appendix H.** Tree analysis should be conducted before any project is executed to avoid damaging root systems of significant trees during excavation.
- **Maximum Length of Pipe Without Access:** Provide access along the alignment of the inlet and outlet pipes of each storage to meet design standards.
- **Utility Locations**: A thorough utility survey should be conducted to identify existing water, gas, electricity, and telecommunications lines.
- **Neighborhood Traffic Restrictions**: A traffic management plan should be developed to address restrictions and maintain safe traffic flow. Detour routes, signage, and communication strategies should be included to minimize inconvenience to residents.
- **Community Outreach for Construction Within Neighborhood**: Residents should be preemptively informed about the project timeline and potential impacts.
- **Presetting and Trash Collection**: Presetting and trash collection measures should be implemented at the upstream end to ease maintenance. Debris should be prevented from entering the storage system, thereby reducing the risk of blockages and maintaining system efficiency.
- **Siting and Restoration of Existing Area**: Siting and restoration within an existing passively operated park provides a range of options for either restoring the park to existing condition or incorporating improvements such as play structures, community spaces, or athletic fields.
- **Continuous Monitoring Active Controls (CMAC)**: All concepts may be further optimized by the use of CMAC, which uses actuated valves in either or both control structures upstream and downstream of the storage to divert and store water at the optimum times to reduce downstream flooding.
- **Storage Type**: Each storage concept, initially designed for either subsurface modular tank system or stormwater park storage, can be re-envisioned as the other type during the detailed design phase.

6.4 Operations and Maintenance Considerations

While specific details on O&M are not included in the scope of work, several important considerations are relevant to ongoing system management:

- **Targeted Modeling and Monitoring**: Continuous assessment of the system is crucial for identifying critical deficiencies. This includes monitoring areas susceptible to sedimentation or structural failures.
- **Critical Issues**: The most pressing concerns within the planning area are likely to arise from sedimentation or pipe collapse, which can significantly affect system capacity.
- **Sediment Capture**: BGSI solutions proposed in the concepts should be designed with requisite tasks such as sediment capture and removal by maintenance crews in mind by including measures such as presetting forebays and/or structures that can be easily accessed by crews for periodic maintenance.

- **Trash Removal**: Trash can be a considerable issue both within the system and within open facilities that are activated only during large storm events. Trash capture and removal should be included in designs and, where appropriate, occur after storm events to restore full system functionality and maintain community safety and site aesthetics.
- **Vegetation Management**: The heavy reliance on vegetation in green infrastructure creates an opportunity for regenerative performance, increased aesthetics, and urban habitat. However, maintenance for more vegetated facilities requires greater consideration in planning. Initial establishment and care of vegetation is critical to the long-term success of green infrastructure and may require increased contractual warranty periods, temporary irrigation for establishment, vegetation protection, and proper soil practices. Routine maintenance should include establishment of the level of service expectations (from hydrologic performance to more stringent aesthetics goals); management of invasive species; knowledge of plants; and appropriate inspection, cutting, and trimming. Finally, vegetation management requires clear coordination of long-term maintenance responsibilities, particularly if involving other parties such as residents, city department conservation groups, and others.
- **Workforce Development**: As more green and blue infrastructure is constructed, the demands on maintenance crews continue to increase. Nationwide, green infrastructure programs have partnered with communities and non-profits to establish workforce development programs to assure there is a qualified workforce to perform long-term maintenance.

In summary, effective O&M strategies should incorporate regular monitoring, targeted assessments of critical areas, and plans for future evaluations to address deficiencies beyond those identified in the current project framework.

7. Concept Prioritization

With the concept designs for each of the proposed projects available, an approach was developed to compare the twelve concept designs for this project against each other and prioritize them based on their relative benefits to the community. To evaluate any BGSI against each other based on their holistic benefits, six scoring criteria were developed. These scoring criteria should not be confused with the technical advantage or feasibility of installing stormwater infrastructure at a specific location, as discussed in Section 4.

Each of these scoring criteria evaluated a different aspect of the overall project and its specific BGSI type at a particular location. These scoring criteria, while developed specifically for the Lakeview study, are intended to be robust and adaptable for use in future studies focused on BGSI as well. Once the projects were scored, weighted factors reflecting CNO's priorities were applied to arrive at a final prioritized list.

7.1 Scoring Criteria

The project costs were compared with six criteria that were scored for every project. All criteria and an instructional sheet can be found in this section. The scoring criteria include annual operations and maintenance (O&M) costs, hydraulic benefits, infrastructure connectivity, enhancement of community amenities and equity, proximity of project to maximize potential partnership opportunities, and cooling potential. The potential to secure community buy-in was initially considered, however, additional community outreach would be necessary to appropriately score this criterion. It should be considered in greater detail in future phases of implementation of the recommended concepts. A scoring system ranging from 1 to 5 was used to evaluate each criterion, with 5 representing the highest score. This highest score assumes the greatest possible community benefit for the given criteria. The six criteria were then weighted based on importance to the City of New Orleans and the cumulative weighted benefit score was compared to the project cost to prioritize the projects based on maximizing the overall benefit relative to the cost. Two criteria were waiting more heavily than others, hydraulic benefit, and proximity; however, the additional scoring criteria reflect the ancillary benefits of the concepts which can work to incentive BGSI placement in strategic locations. Proximity was weighted more heavily to reflect potential partnership opportunities with future infrastructure projects.

7.1.1 Operations and Maintenance Annual Cost

The objective of this criterion was to prioritize opportunities that offer the most cost-effective solutions for annual operations and maintenance. Sites were rated based on their unit price per cubic foot (CF) for O&M costs using the rating scale in Figure 7-1. This rating system helped to identify and prioritize projects that provide the greatest operational efficiency for the lowest cost. The O&M costs were determined using the same tools, iDST, CLASSIC, and the International BMPDB, as the construction costs. The iDST calculated O&M costs by using predefined cost estimates for various stormwater control measures, considering factors like size, type, and expected lifespan. Values were compared to the BMPDB and CLASSIC tools, which calculate their O&M costs by collecting data on BMP performance and maintenance activities, and using a cost annualization model, respectively.

Figure 7-1. O&M Site Rating

Site Rating	Description
A	0-0.3
B	0.3-0.7
C	0.7-1.1
D	1.1-1.5
E	> 1.5

	O&M Unit Price ($/CF/year)	0-0.3	0.3-0.7	0.7-1.1	1.1-1.5	> 1.5
	Site Rating	A	B	C	D	E
BMP Type	Tree Planting	5	4	3	2	1
	Sunken Garden	5	4	3	2	1
	Tree Boxes	5	4	3	2	1
	Trenches	5	4	3	2	1
	Vegetated Bioswales	5	4	3	2	1
	Stormwater Park	5	4	3	2	1
	Box Culvert	5	4	3	2	1
	Permeable Pavements	5	4	3	2	1
	Green Roof	5	4	3	2	1
	Modular Storage Tank	5	4	3	2	1

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept Z costs $0.50/CF for O&M annually, giving it a B rating. Since Concept Z is a stormwater park and has a B rating, it will receive a score of 4.

7.1.2 Hydraulic Benefit

The objective of this criterion was to estimate the hydraulic benefit provided by various projects. Sites were assigned a baseline hydraulic benefit score based on the modeled flood volume reduction proportional to the benchmark value of 5 MGAL for a score of 5 as shown in Figure 7-2. Hydraulic benefit refers to the enhanced capacity to store water during heavy rainfall events, aiding in effective stormwater runoff management. BGSI practices that offer a significant hydraulic benefit received higher scores.

In addition to the hydraulic benefit assessed using flood volume reduced, an additional score was developed to reflect the proximity of the project hot spots based on the existing flooding conditions. The value of the hot spot factors (HSF) is generally higher for a project the closer it is to a known hot spot. Based on the existing flood conditions, the hot spot factors (HSF) are determined by specific distance ranges. For distances between 0 and 25 feet, the HSF is 1.1, indicating the highest risk areas. As the distance increases to between 26 and 100 feet, the HSF decreases to 1, reflecting a moderate risk. For distances from 101 to 250 feet, the HSF further reduces to 0.9, and for 251 to 500 feet, it drops to 0.8. Finally, for distances ranging from 501 to 10,000 feet, the HSF is 0.75, indicating the lowest risk areas under the given conditions. These factors help in assessing and managing flood risks effectively based on proximity to existing flood conditions.

Figure 7-2. Hydraulic Benefit Rating

Site Rating	Description
A	Priority basin based on modeling results
B	
C	Some flood reduction
D	
E	Minimal flood reduction

Sub-Criteria	Data Type	Data Values				
	Effective Flood Volume Managed (MGAL)	> 10	5-10	1-5	0.2-1	0-0.2
	Site Rating	A	B	C	D	E
BMP Type	Tree Planting	5	4	3	2	1
	Sunken Garden	5	4	3	2	1
	Tree Boxes	5	4	3	2	1
	Trenches	5	4	3	2	1
	Vegetated Bioswales	5	4	3	2	1
	Stormwater Park	5	4	3	2	1
	Box Culvert	5	4	3	2	1
	Permeable Pavement	5	4	3	2	1
	Green Roof	5	4	3	2	1
	Modular Storage Tank	5	4	3	2	1

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept Y will hold roughly 3 MGAL upon completion, so it will receive a C rating. Since Concept Y is a green roof with a C rating, it will receive a score of 3.

7.1.3 Infrastructure Connectivity

The objective of this criterion is to prioritize opportunities that enhance connectivity, mobility, and safety. Sites are rated based on their level of public accessibility, improvements to mobility, and contributions to safety, with the rating scale in Figure 7-3. This rating system helps to identify and prioritize projects that provide the greatest benefits in terms of infrastructure connection.

CNO has partnered with the Trust for Public Land to identify key areas for implementing green infrastructure. This initiative aims to provide equity, health, climate, and community benefits. The Trust for Public Land data was utilized in determining the connectivity score (Trust for Public Land 2023).

Connectivity improvements can stimulate economic activities, increase opportunities, improve health and wellbeing, and reduce isolation. Higher scores will be assigned to BGSI projects that enhance connectivity to employment centers, essential services, tourist destinations, or public schools. Concepts that reduce gaps in park access, bike networks, and public transportation are also desirable. Additionally, increasing the safety of pedestrians and cyclists is essential.

Figure 7-3. Infrastructure Connectivity Site Rating

Site Rating	Description
A	Very High - Very high public accessibility, improves mobility, and contributes to safety
B	High - High public accessibility, improves mobility, and contributes to safety
C	Medium - Some public accessibility, some public mobility, some contributions to safety
D	Low - Low accessibility, hinders mobility, low safety contributions
E	Null - Little to no accessibility, hinders mobility, little to no safety contributions

	Data Type	Data Values				
Sub-Criteria	Combined Connect Priorities	Very High	High	Medium	Low	Null
	Site Rating	A	B	C	D	E
BMP Type	Tree Planting	4	3	3	2	2
	Sunken Garden	5	4	3	2	2
	Tree Boxes	4	3	3	2	2
	Trenches	3	3	2	2	1
	Vegetated Bioswales	4	4	3	3	2
	Stormwater Park	2	2	3	3	4
	Box Culvert	2	2	2	2	2
	Permeable Pavements	4	3	3	2	2
	Green Roof	4	3	2	1	1
	Modular Storage Tank	2	2	3	3	4

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept X's site area meets one Very High, three High, and one Medium sub-criteria. This would give it an average rating of B. Since Concept X is a bioswale with a B rating, it will receive a score of 4.

7.1.4 Maximize Community Amenities and Equity

The objective of this criterion is to prioritize BMPs and GSI opportunities that increase green space and/or educational opportunities, especially in areas meeting environmental and social justice (ESJ) triggers or assessment opportunities. Sites are rated based on their potential to provide community amenities, with the rating scale in Figure 7-4. This rating system helps to identify and prioritize projects that offer the greatest benefits in terms of community amenities and equity. The Trust for Public Land data was utilized in determining the equity score, ensuring that projects are aligned with community needs and priorities (Trust for Public Land 2023).

Figure 7-4. Equity Site Rating

	Data Type	Data Values (Block Scale)				
Sub-Criteria	Combined Climate Equity Priorities	Very High	High	Medium	Low	Null
	Site Rating	A	B	C	D	E
BMP Type	Tree Planting	5	4	4	3	3
	Sunken Garden	4	4	3	3	2
	Tree Boxes	4	4	3	2	2
	Trenches	1	1	2	2	2
	Vegetated Bioswales	5	4	4	3	3
	Stormwater Park	5	5	4	4	3
	Box Culvert	3	2	2	2	2
	Permeable Pavements	2	1	1	1	1
	Green Roof	3	3	2	1	1
	Modular Storage Tank	3	2	2	2	2

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept W's site area meets two Very High and one Null sub-criteria. This would give it an average rating of A. Since Concept W is a tree planting with an A rating, it will receive a score of 5.

7.1.5 Maximize Partnership Opportunities (Proximity)

The objective of this criterion is to prioritize the alignment of GSI projects to leverage ROW and other neighborhood projects, preferably in areas that provide multiple benefit opportunities. Sites are rated based on their potential to enhance other projects through cost sharing, construction efficiency, and planning efficiency using the rating scale in Figure 7-5. This rating system helps to identify and prioritize projects that offer the greatest partnership opportunities. The proximity to recent and active SWBNO and CNO DPW project(s) data was collected during Task 1 data collection.

Figure 7-5. Proximity Site Rating

Site Rating	Description
A	Opportunity to enhance another project with cost sharing
B	Opportunity for construction efficiency (mobilization, TESC, Traffic control etc.)
C	Opportunity for planning efficiency (traffic plans, outreach, SIP permit etc.)
D	No alignment with other projects
E	Alignment with recently constructed projects (estimated completion in 2020)

	Data Type	Data Values				
		A	B	C	D	E
Sub-Criteria	Roadwork Projects	Cost share with project	Alignment with project	Opportunity for planning efficiency	No alignment	Alignment with recently constructed projects
	06A_SWBNO Projects	Cost share with project	Alignment with project	Opportunity for planning efficiency	No alignment	Alignment with recently constructed projects
	Site Rating	**A**	**B**	**C**	**D**	**E**
BMP Type	Tree Planting	3	3	2	2	2
	Sunken Garden	5	4	3	2	1
	Tree Boxes	3	3	2	2	1
	Trenches	3	3	2	2	1
	Vegetated Bioswales	4	4	3	2	1
	Stormwater Park	5	4	3	2	1
	Box Culvert	5	4	3	2	1
	Permeable Pavements	4	4	3	2	1
	Green Roof	5	4	3	1	1
	Modular Storage Tank	5	4	3	2	1

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept V site is one box culvert aligned with a previously constructed project meeting an E sub-criterion, and one Modular tank system not aligned with any active project meeting a D sub-criterion. For proximity, the average score of 2.5 including the 5 (box culvert) and 2 (modular storage tank) is applied.

7.1.6 Prioritize Areas Requiring Cooling

The objective of this criterion is to prioritize opportunities that provide shade in locations identified as requiring cooling. Sites are rated based on their potential to mitigate urban heat island effects, with the rating scale detailed in Figure 7-6. This rating system helps to identify and prioritize projects that offer the greatest cooling benefits. The cooling score is based on data from the Trust for Public Land data assuring that projects are aligned with areas most in need of cooling interventions.

Figure 7-6. Cooling Site Rating

Site Rating	Description
A	Very High - Areas that are daytime urban heat island hot spots
B	High -
C	Medium - Areas that have a medium risk of urban heat island hot spots
D	Low
E	Null - Areas not identified as potential urban heat island hot spots

	Data Type	Data Values				
Sub-Criteria	TPL Cool Priorities	Very High	High	Medium	Low	Null
	Site Rating	A	B	C	D	E
BMP Type	Tree Planting	5	4	3	2	2
	Sunken Garden	4	3	2	2	2
	Tree Boxes	5	4	3	2	2
	Trenches	1	1	1	1	1
	Vegetated Bioswales	4	3	2	2	2
	Stormwater Park	2	2	2	1	1
	Box Culvert	1	1	1	1	1
	Permeable Pavements	1	1	1	1	1
	Green Roof	1	1	1	1	1
	Modular Storage Tank	1	1	1	1	1

Notes:

1. High score,5, is shown as green, and lowest score,1, is shown as red.
2. Example Calculation: Concept U's site area fits three High and one Null sub-criteria. This would give it an average rating of B. Since Concept U is a box culvert with a B rating, it will receive a score of 1.

7.1.7 Maximize Community Buy-in

The objective of this criterion is to prioritize opportunities that minimize impacts to competing community needs, such as existing street use. This criterion would prioritize projects that offer the greatest community buy-in by minimizing disruptions to or enhancing everyday activities. This category was not considered as a formal community survey has not been completed to determine community buy-in.

7.2 Concept Scoring and Ranking

This section presents the scores for each project based on the criteria outlined in the previous section. Through application of these criteria, each project was evaluated and ranked to prioritize those with the greatest benefits. The tables listed below summarize the scores for each criterion.

- Table 7-1 - Operation and Maintenance Cost Score
- Table 7-2 - Hydraulic Benefit Score
- Table 7-3 - Infrastructure Connectivity Score
- Table 7-4 - Maximize Community Amenities and Equity Score
- Table 7-5 - Maximize Partnership Opportunities Score
- Table 7-6 - Prioritize Areas Requiring Cooling Score
- Table 7-7 – Scoring Criteria Weight
- Table 7-8 – Concept Ranking by their Weighted Score
- Table 7-9 - Flood Metric and Cost Summary
- Maximize Community Buy-in – Not scored

After each project was scored, weights were assigned to each criterion to reflect their relative importance. The weights were determined based on input and direction from CNO, which was received during the BGSI workshop and during project update meetings. The weighting selected emphasizes the importance hydraulic benefit and cost with potential to maximize partnership opportunities being secondary due to potential cost savings and community benefits. Scores are then normalized to a maximum value of 100 for a project that scores a 5 across all criteria.

The weighted score and ranking of each of the projects is provided in Table 7-8. The rankings provide an assessment of the proposed projects, highlighting their relative strengths and potential contributions to flood mitigation and community enhancement and are grouped into tiers based on their benefit to cost ration for consideration of implementation priority. This systematic approach allocates resources efficiently and ensures that the selected projects align with the overall goals and objectives of the initiative. A weighted benefit versus cost graph is shown in Figure 7-7, and project tier related to weighted benefit versus cost are discussed in Section 8.1.

Table 7-1. O&M Cost Scores

ID	Concept Name	Type	O&M Unit Cost	O&M Cost Score	Avg. O&M Cost Score
1	Harlequin Park	Modular Storage Tank	0.73	3	3
2	Tourmaline Park	Modular Storage Tank	0.73	3	3
3A	Tiara and Peridot Park Inline	Stormwater Park	35.69	1	1
3B	Tiara and Peridot Park Offline	Stormwater Park	18.02	1	1
4	Marconi Levee	Stormwater Park	15.50	1	1
5	Upper West End Blvd.	Stormwater Park	14.18	1	1
6	Mouton Street	▪ Modular tank system ▪ Modular tank system ▪ Box Culvert	0.76 0.76 0.30	3 3 5	4.3
7	Harrison Avenue	▪ Sunken Garden ▪ Box Culvert ▪ Permeable Pavement	1.50 0.30 2.00	2 5 1	2.7
8	Hynes Elementary	▪ Bioswale ▪ Modular Storage Tank ▪ Green Roof	7.81 0.77 0.50	1 3 4	4.3
9	Germain Street	▪ Box Culvert ▪ Modular Storage Tank	0.30 0.77	5 3	4.5
10	Canal Blvd.	Box Culvert	0.30	5	5
11	New Basin Canal Park	Stormwater Park	9.90	5	5
12	Kenilworth Street	Stormwater Park	13.64	5	5

ID	Concept Name	Type	O&M Unit Cost	O&M Cost Score	Avg. O&M Cost Score
13	Combined	All projects	0.8	3	3

Table 7-2. Hydraulic Benefit Score

ID	Concept Name	Flood Volume Reduced (MGAL)	Baseline Hydraulic Benefit Score	Hot Spot Factor (HSF)	Hydraulic Benefit + HSF Score
1	Harlequin Park	1.9	1.9	0.75	1.7
2	Tourmaline Park	2.3	2.3	0.8	2.5
3A	Tiara and Peridot Park Inline	0.2	0.2	0.8	0.2
3B	Tiara and Peridot Park Offline	1.1	1.1	0.8	1.2
4	Marconi Levee	1.6	1.6	1	1.8
5	Upper West End	2.0	2.0	1	2.2
6	Mouton Street	1.0	1.0	1.1	1.3
7	Harrison Avenue	2.7	2.7	1	3
8	Hynes Elementary School	0.8	0.8	0.9	0.9
9	Germain Street	0.7	0.7	1.1	0.9
10	Canal Blvd.	0.4	0.4	1.1	0.5
11	New Basin Canal	4.9	4.9	1	5.4
12	Kenilworth Street	2.2	2.2	1.1	2.8
13	Combined	14.8	14.8	1.1	18.5

Table 7-3. Infrastructure Connectivity Scores

ID	Concept Name	Type	Connect Rating	Connect Score	Avg. Connect Score
1	Harlequin Park	Modular Storage Tank	Medium	3	3.0
2	Tourmaline Park	Modular Storage Tank	Medium	3	3.0
3A	Tiara and Peridot Park Inline	Stormwater Park	Medium	3	3.0
3B	Tiara and Peridot Park Offline	Stormwater Park	Medium	3	3.0
4	Marconi Levee	Stormwater Park	High	2	2.0
5	Upper West End Blvd.	Stormwater Park	Medium	3	3.0
6	Mouton Street	▪ Modular tank system ▪ Modular tank system ▪ Box Culvert	▪ Null ▪ Null ▪ High	4 4 2	3.3
7	Harrison Avenue	▪ Sunken Garden ▪ Box Culvert ▪ Permeable Pavement	▪ Medium ▪ Very High ▪ Very High	3 2 4	3.0
8	Hynes Elementary	▪ Bioswale ▪ Modular Storage Tank ▪ Green Roof	▪ High ▪ Medium ▪ Very High	4 3 4	3.7
9	Germain Street	▪ Box Culvert ▪ Modular Storage Tank	▪ High ▪ Medium	3 2	2.5
10	Canal Blvd.	Box Culvert	Very High	2	2.0
11	New Basin Canal Park	▪ Box Culvert ▪ Stormwater Park	Very High Medium	2 3	2.5
12	Kenilworth Street	Stormwater Park	Null	4	4.0
13	Combined	All Concepts	-	-	2.9

Table 7-4. Equity Cost Scores

ID	Concept Name	Type	Equity Rating	Equity Score	Avg. Equity Score
1	Harlequin Park	Modular Storage Tank	Null	2	2.0
2	Tourmaline Park	Modular Storage Tank	Null	2	2.0
3A	Tiara and Peridot Park Inline	Stormwater Park	Null	3	3.0
3B	Tiara and Peridot Park Offline	Stormwater Park	Null	3	3.0
4	Marconi Levee	Stormwater Park	Null	3	3.0
5	Upper West End Blvd.	Stormwater Park	Null	3	3.0
6	Mouton Street	▪ Modular tank system ▪ Modular tank system ▪ Box Culvert	▪ Medium ▪ Medium ▪ Medium	2 2 2	2.0
7	Harrison Avenue	▪ Sunken Garden ▪ Box Culvert ▪ Permeable Pavement	▪ Null ▪ Medium ▪ Medium	2 2 1	1.7
8	Hynes Elementary	▪ Bioswale ▪ Modular Storage Tank ▪ Green Roof	▪ Medium ▪ Medium ▪ Medium	4 2 2	2.7
9	Germain Street	▪ Box Culvert ▪ Modular Storage Tank	▪ Medium ▪ Medium	2 2	2.0
10	Canal Blvd.	Box Culvert	Null	2	2.0
11	New Basin Canal Park	▪ Box Culvert ▪ Stormwater Park	▪ Null ▪ Null	2 3	2.5
12	Kenilworth Street	Stormwater Park	Null	3	3.0
13	Combined	All Concepts	-	-	2.4

Table 7-5. Proximity Cost Scores

ID	Concept Name	Type	Proximity Rating	Proximity Score	Avg. Proximity Score
1	Harlequin Park	Modular Storage Tank	None -D	2	2.0
2	Tourmaline Park	Modular Storage Tank	None – D	2	2.0
3A	Tiara and Peridot Park Inline	Stormwater Park	None – D	1	1.0
3B	Tiara and Peridot Park Offline	Stormwater Park	None – D	2	2.0
4	Marconi Levee	Stormwater Park	None – D	2	2.0
5	Upper West End Blvd.	Stormwater Park	None – D	2	2.0
6	Mouton Street	▪ Modular tank system ▪ Modular tank system ▪ Box Culvert	▪ None – D ▪ None – D ▪ Completed - E	2 2 1	1.7
7	Harrison Avenue	▪ Sunken Garden ▪ Box Culvert ▪ Permeable Pavement	▪ Planned - A ▪ Planned - A ▪ Planned - A ▪	5 5 4	4.7
8	Hynes Elementary	▪ Bioswale ▪ Modular Storage Tank ▪ Green Roof	▪ None - D ▪ None - D ▪ None - D	2 2 1	1.7
9	Germain Street	▪ Box Culvert ▪ Modular Storage Tank	▪ None - D ▪ Complete - E	2 1	1.5
10	Canal Blvd.	Box Culvert	Completed - E	1	1.0
11	New Basin Canal Park	▪ Box Culvert ▪ Stormwater Park	▪ Planned - A ▪ None – D	5 2	3.5
12	Kenilworth Street	Stormwater Park	None - D	2	2.0
13	Combined	All Concepts	-	-	2.1

Table 7-6. Cooling Cost Scores

ID	Concept Name	Type	Cooling Rating	Cooling Score	Avg Cooling Score
1	Harlequin Park	Modular Storage Tank	Null	2	2.0
2	Tourmaline Park	Modular Storage Tank	Null	2	2.0
3A	Tiara and Peridot Park Inline	Stormwater Park	Null	3	3.0
3B	Tiara and Peridot Park Offline	Stormwater Park	Null	3	3.0
4	Marconi Levee	Stormwater Park	Null	3	3.0
5	Upper West End Blvd.	Stormwater Park	Null	4	4.0
6	Mouton Street	▪ Modular tank system ▪ Modular tank system ▪ Box Culvert	▪ Medium ▪ Medium ▪ Medium	2 2 2	2.0
7	Harrison Avenue	▪ Sunken Garden ▪ Box Culvert ▪ Permeable Pavement	▪ Medium ▪ High ▪ High	3 2 1	2.0
8	Hynes Elementary	▪ Bioswale ▪ Modular Storage Tank ▪ Green Roof	▪ Medium ▪ Medium ▪ Medium	4 2 2	2.7
9	Germain Street	▪ Box Culvert ▪ Modular Storage Tank	Medium Medium	2 2	2.0
10	Canal Blvd.	Box Culvert	Medium	2	2.0
11	New Basin Canal Park	▪ Box Culvert ▪ Stormwater Park	▪ Medium ▪ Medium	2 4	3.0
12	Kenilworth Street	Stormwater Park	Null	3	3.0
13	Combined	All Concepts		-	2.5

Table 7-7. Scoring Criteria Weights

Criteria	Weight	Notes
Construction Cost	N/A	▪ Highly prioritized by CNO ▪ Plotted directly against the benefits (see Section 7.2)
O&M Annual Cost	5	
Hydraulic Benefit	65	Highly prioritized by CNO
Infrastructure Connectivity	5	
Maximize Community Amenities and Equity	5	
Maximize Partnership Opportunities (Proximity)	15	Secondary added benefit of potential reduced costs through partnership and reduction of impacts on the community.
Prioritize Areas Requiring Cooling	5	
Maximize Community Buy-in	N/A	This has been removed as a criterion through weighting until official community survey can be conducted.

Table 7-8. Concept Ranking – Score (Weighted Score)

ID	Concept	Cost ($)	O&M	Hydraulic Benefit	Connect-ivity	Equity	Proximity	Cooling	Weighted Benefit Score	Benefit Cost Ratio
		Weight	5%	65%	5%	5%	15%	5%		
1	Harlequin Park	$5,170,000	3.0	22.1	3.0	2.0	6.0	2.0	38.1	7.4
2	Tourmaline Park	$10,460,000	3.0	32.5	3.0	2.0	6.0	2.0	48.5	4.6
3A	Tiara and Peridot Park	$19,630,000	1.0	2.6	3.0	3.0	3.0	3.0	15.6	0.8
3B	Tiara and Peridot Park	$4,170,000	1.0	15.6	3.0	3.0	6.0	3.0	31.6	7.6
4	Marconi Levee	$1,810,000	1.0	23.4	2.0	3.0	6.0	3.0	38.4	21.2
5	Upper West End	$6,030,000	1.0	28.6	3.0	3.0	6.0	4.0	45.6	7.6
6	Mouton Street	$4,560,000	4.0	16.9	3.3	2.0	5.0	2.0	33.2	7.3
7	Harrison Avenue	$13,700,000	2.0	39.0	3.0	1.7	14.0	2.0	61.7	4.5
8	Hynes Elementary School	$8,940,000	1.0	11.7	3.7	2.7	5.0	2.7	26.7	3.0
9	Germain Street	$3,500,000	3.0	11.7	2.5	2.0	4.5	2.0	25.7	7.3
10	Canal Blvd.	$82,310,000	5.0	6.5	2.0	2.0	3.0	2.0	20.5	0.2
11	New Basin Canal	$9,600,000	1.0	70.2	2.5	2.5	10.5	3.0	89.7	9.3
12	Kenilworth Street	$2,690,000	1.0	36.4	4.0	3.0	6.0	3.0	53.4	19.9
13	Combined	$172,570,000	2.1	240.5	2.9	2.4	3.0	2.6	253.5	1.5

Figure 7-7. Weighted Benefit vs. Cost Graph

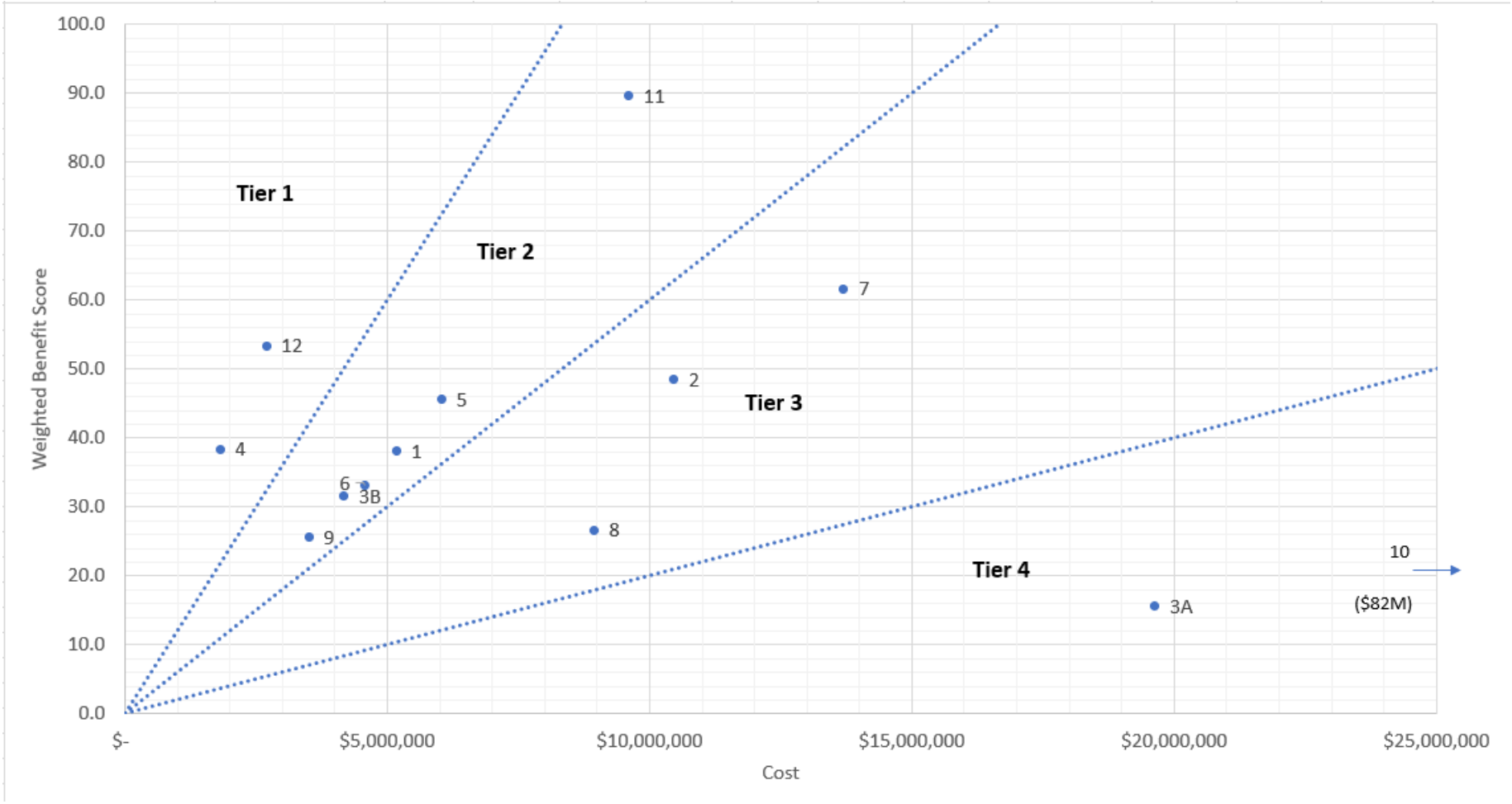


Table 7-9. Flood Metric and Cost Summary

ID	Project	Flood Volume Reduced (MGAL)	Footprint of Flood Reduction > 1 in (acres)	Average WSE Flood Reduction (in.)	Total Cost	Weighted Benefit Score
1	Harlequin Park	1.9	6.4	-2	$5,170,000	38.1
2	Tourmaline Park	2.3	1.2	-2	$10,460,000	48.5
3A	Tiara and Peridot Park	0.2	1	-3	$19,630,000	15.6
3B	Tiara and Peridot Park	1.1	0.6	-2	$4,170,000	31.6
4	Marconi Levee	1.6	14.1	-2	$1,810,000	38.4
5	Upper West End	2	0.7	-2	$6,030,000	45.6
6	Mouton Street	1	0.3	-2	$4,560,000	33.2
7	Harrison Ave	2.7	2.2	-2	$13,700,000	61.7
8	Hynes Elementary School	0.8	0.2	-2	$8,940,000	26.7
9	Germain Street	0.7	0	-2	$3,500,000	25.7
10	Canal Blvd	0.4	24.5	-1	$82,310,000	20.5
11	New Basin Canal	4.9	37.5	-1	$9,600,000	89.7
12	Kenilworth Street	2.2	5.8	-4	$2,690,000	53.4

8. Summary and Recommendations

As noted in the modeling and scoring summaries, this study has identified BGSI concepts that can reduce flood in the Lakeview study area. However, as demonstrated in the modeling, a suite of BGSI and gray infrastructure investments are likely necessary to significantly reduce the flooding and risk. The recommendations below emphasize a phased implementation of investments to maximize immediate benefits, overall benefits relative to cost and exploit opportunities for synergy with other investments in the neighborhood.

8.1 Summary of Recommended Concepts

Based on an analysis of the modeling results and the evaluation of 13 proposed concepts using flood metrics and scoring criteria, a set of targeted recommendations to optimize flood mitigation efforts in the study area was developed. These recommendations are designed to address the most critical issues identified, including downstream flood risk, persistent surcharging in the major system, and localized flooding hot spots, where feasible. Figure 7-7 summarizes the weighted benefit scores compared to cost for each of the 12 concepts. This chart was divided into four tiers according to the apparent cost benefit to guide the prioritization and implementation of the proposed solutions, discussed as follows. The following points summarize the recommendations to guide the prioritization and implementation of the proposed solutions:

- **Prioritize Tier 1 High-impact Concepts independent of DPS improvements:** Based on the project scoring results, Concepts 4 (Marconi Levee) and 12 (Kenilworth Street should be prioritized due to their highest overall rankings. These projects demonstrate significant hydraulic benefits and cost efficiency, making them key candidates for effective flood mitigation. These projects appear to show less hydraulic influence from downstream backwater conditions created by the pumps making them more cost-effective in the short-term to reduce localized flooding impacts. They are also located in underutilized open space providing significant opportunity to address flooding while enhancing community spaces.
- **Prioritize Tier 2 Investments that will complement gray infrastructure improvements and address locations of the highest flooding.** Concepts 1, 3B, 6, 9 and 11 show strong performance in cost efficiency and hydraulic benefits, indicating their potential for flood risk reduction particularly in the locations where there is the greatest flooding. Modeling indicates that these projects will be more effective when paired with gray infrastructure improvements (such as DPS improvements) to improve the downstream capacity while also reducing the potential impacts of increasing conveyance on downstream infrastructure. Concepts 6 (Mouton Street) and 9 (Germain Street), directly address localized neighborhood flooding and stand out as areas with significant flooding depth within the areas east of Canal most impacted by flooding. However, their net impact will be most effective when considered with improvements to the downstream system. Concepts 1, 3B and 11 all effectively utilize open space outside of the areas of the highest flooding to retain runoff volume and delay flows to flooded areas and subsequently the DPSs. The additional storage capacity and improved conveyance at this location will have a broad spatial impact, mitigating flooding in low-lying areas. Prioritizing these high-impact projects will make the most of available resources and improve flood management in synergy with gray infrastructure improvements.
- **Opportunistically Pursue Tier 3 Concepts that have synergy with other city investments.** Concepts 2, 5, 7 and 8 are hydraulically effective projects (particularly when combined with gray infrastructure improvements) but have a lower benefit to cost ratio. However, if combined with other pending city

projects, such as improvements to Harrison Avenue (Concept 7), can significantly reduce the net cost to the City, maximize benefits and avoid lost opportunity to integrate stormwater management at those locations without additional community disruption and mobilization. Concept 5 (Upper West End) in particular, may have increased value if additional drainage area can be plumbed this location from the West End or other locations but under the current configuration has a significant conveyance cost relative to the hydraulic benefit.

- **Optimize (or defer) Inefficient Tier 4 projects.** Concepts 3A (Tiara Park, inline) and 10 (Canal) in their current configuration are not cost-effective. Moreover, there are large uncertainties with the cost of a major undertaking such as outlined and could be significantly underestimated. Regardless, the very low benefit vs. cost is clear. The ideas presented in Concept 3B may be combined with Concept 3A, such as methods to maximize the available storage volume, however, model results indicate that as an inline surge pond this concept is less hydraulically efficient at reducing downstream flood volumes than the modeling of Concept 3B as an offline configuration. Canal Boulevard (Concept 10) in its entirety may be infeasible from a cost and implementation perspective. However, it may be that further modeling refinement may indicate targeted expansion of the box culvert system may have greater efficiency at reducing upstream flooding for a reduced cost.
- **Address Persistent Surcharging:** Implement conveyance improvements to the major system to address persistent surcharging unrelated to pump capacity limitations. This will provide additional relief to hot spot areas and improve overall system performance.
- **Enhance Storage and Conveyance:** Integrate BGSI with conveyance improvements to enhance storage and reduce flood risk. Storage and conveyance concepts should be implemented to improve backwater conditions and overall flood mitigation.
- **Conduct Further Investigations:** A thorough investigation into the condition of the stormwater collection system's capacity and necessary pumping station upgrades is recommended. Such an investigation will help address intense backwater conditions along the backbone of the system and increase average reductions in flood depth.

By prioritizing these high-impact projects and addressing key issues such as surcharging and localized flooding hot spots, the proposed solutions are aimed at optimizing flood mitigation efforts through a combination of structural and green infrastructure approaches. These recommendations provide opportunities to address the identified flooding challenges and positively impact the community.

8.2 Preliminary Phasing Recommendations

The hydraulic analysis reveals that system capacity challenges in the Lakeview area are complex, comprising deficiencies in the local conveyance system, hydrologic impacts of urbanization, local conveyance capacity limitations, and lack of storage.

Most concepts will have limited impact until combined with other concepts and/or DPS improvements. Analysis demonstrates that all concepts offer some benefit. As noted in Section 8.1, the Jacobs team recommends numerous factors for consideration in project prioritization. During project phasing, opportunities for co-development with other city departments and projects should be considered to reduce costs, minimize public impacts, and maximize benefits.

Phasing should also account for the relative impacts and interdependencies of improvements. The following interdependencies between projects should be considered when developing the phasing strategy:

- Both the Germain Street (Concept 9) and Mouton Street (Concept 6) projects improve conveyance to Canal Boulevard while providing flow control to mitigate downstream impacts. Concept phasing should consider the potential reliance on DPS upgrades to reduce backwater conditions.
- Both Canal Boulevard (Concept 10) and Harrison Avenue (Concept 7) are currently presented as single projects. However, due to their scale, they may require phasing to balance budget constraints with available funding, opportunistically co-develop with other improvements (e.g., roadway upgrades), and reduce community impacts. Generally, full schematic design for these improvements should be conducted concurrently, with construction ideally phased from downstream to upstream to minimize downstream impacts. Concept 10 is generally not recommended due to cost and hydraulic benefit.
- New Basin Canal Park (Concept 11) and the west end of Harrison Avenue (Concept 7) are highly interconnected and should, at minimum, be phased to undergo concurrent schematic-level design.
- Harlequin Park (Concept 1) and Tourmaline Park (Concept 2), being upstream in the basin, likely require less significant coordination with other projects in terms of phasing.
- Marconi Levee (Concept 4) is hydraulically independent of the other projects and may be phased independently.

All concepts should be individually phased to minimize traffic impacts and maintain conveyance capacity throughout construction.

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Appendix A. Task 1 – Data Collection and Technical Memo

Task 1: Data Collection & Analysis Technical Memorandum - FINAL

Document no: 0
Version: 1

The City of New Orleans
DPW 724 / K23-196

Hydrological and Hydraulic Drainage Study – Lakeview N & S
April 19, 2024

Task 1: Data Collection & Analysis Technical Memorandum - FINAL

Client name:	The City of New Orleans		
Project name:	Hydrological and Hydraulic Drainage Study – Lakeview N & S		
Client reference:	DPW 724 / K23-196	**Project no:**	D3791500
Document no:	0	**Project manager:**	M. Stochl
Version:	1	**Prepared by:**	MS / KM / ER / JT / PR
Date:	April 19, 2024	**File name:**	CNO_HHLV_TM1_Final

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1. Introduction

1.1 Study Background

The City of New Orleans (CNO) contracted with Jacobs Engineering Group, Inc. (Jacobs) to prepare a comprehensive hydrologic and hydraulic (H&H) drainage study for the Lakeview North and South neighborhood. The project area is shown in Figure 1-1. The study includes a survey of major drainage structures (greater than or equal to 36 inches), updates and improvements to the City's existing Personal Computer Storm Water Management Model (PCSWMM) model of the area, preparation of drainage improvement concept designs, and development of a prioritized list of drainage improvements that include a combination of both green infrastructure (GI) and gray infrastructure improvements to enhance the performance of the drainage system thereby reducing flood risk. This study will advance the City's Living with Water Plan and Greater New Orleans Urban Water Plan by moving from general concepts of promoting infiltration and storage of stormwater runoff to focused recommendations for siting, design, and prioritized implementation of GI measures and drainage improvements that promote community resilience.

1.2 Study Purpose

The purpose of this study is to assist CNO in developing holistic conceptual designs that focus on implementable, high-quality, equitable, and cost-effective drainage solutions for the Lakeview North and South neighborhood.

The study will include the following:

- Understanding of problem areas and hotspots in the Lakeview drainage basin
- Review and analysis of existing data sources that provide the study basis
- Conceptual designs and prioritization of projects and alternatives consisting of both green infrastructure and gray infrastructure solutions that can be applied at a neighborhood level while considering ongoing programs such as the Southeast Louisiana Flood Control Program, Hazard Mitigation Grant Program, and Joint Infrastructure Program as well as future programs
- Information to prioritize strategic infrastructure investments for mitigating flood risk
- Assessment of project benefits, public acceptance, and potential funding sources
- Consideration of community impacts and benefits to Lakeview

1.3 Technical Memorandum Purpose

This purpose of this technical memorandum (TM) is to document the result of Task 1: Data Collection. Specifically, this TM documents existing model setup, identifies data gaps, and delineates a strategy for updating the model. Additionally, this TM summarizes the collected data and the associated analysis.

LEGEND

- Lakeview H&H Study Boundary
- Drainage Pump Station

0 0.13 0.25 0.5 Miles

Figure 1-1:
Lakeview North and South Project Area
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\111023_FIELDVISIT\CNO_FIELDMAP_WINDEX.APRX 3/14/2024 7:30 PM

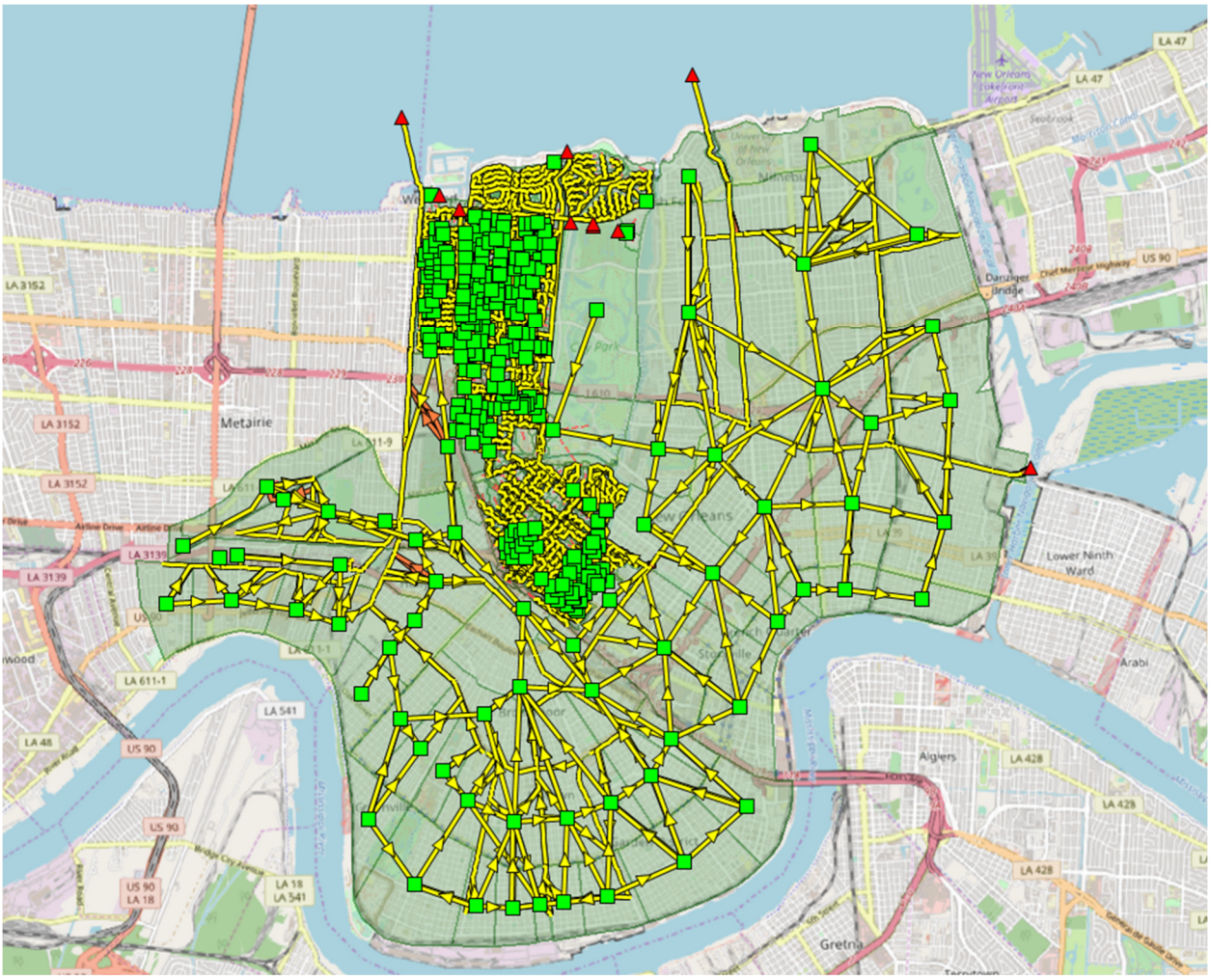
2. Data Collection and Analysis

This section details the data collection and analysis process and results. A Data Log, provided in Appendix A, provides a complete listing of the information collected and its relevance to the study.

2.1 Existing Conditions Model

CNO provided a PCSWMM model of the City of New Orleans. The timeline, background of model development, and validation details of the existing conditions model are summarized in Section 3. A graphic of the model is shown in Figure 2-1. The model has been previously managed and updated by Ardurra on behalf of the Sewerage and Water Board of New Orleans (SWBNO).

Figure 2-1 PCSWMM Model Graphic



2.2 Related Documentation and Studies

The following reports were reviewed in depth and are discussed below as relevant to the existing conditions model:

- The City of New Orleans Stormwater Management Capital Improvements Plan (CDM Smith, 2012)
- Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems (BCG Engineering and Consulting, Inc., 2016)
- Stormwater Master Plan Report (prepared for SWBNO by Ardurra and ILSI Engineering, 2022)

2.2.1 The City of New Orleans Stormwater Management Capital Improvements Plan (CDM Smith, 2012)

The City of New Orleans Stormwater Management Capital Improvements Plan (CDM Smith, 2012) presents the results of hydrologic and hydraulic modeling representing the City's stormwater system. This modeling was conducted using the Environmental Protection Agency's (EPA) Storm Water Management Model (SWMM). The report consists of the model development, the design methodology, detailed model results, a map book of the existing system, and a map book of the proposed system with recommendations for capacity upgrades. The City was split into 15 project areas based on the SWBNO pump station service areas. The model uses Light Detection and Ranging (LIDAR) data from the Louisiana Statewide LIDAR Project (starting in 2000, root-mean-square error, in a range from 6–12 in.), National Land Cover data from 2001, and the Natural Resources Conservation Service (NRCS) Soil Survey Geographic Database (SSURGO).

The model's desired level of service (LOS) for the Stormwater Management Capital Improvement Plan was established as no more than six inches of street flooding for a 24-hour storm duration with 8.5 inches of rainfall (10-year event, based on the 1954 to 2009 records).

Validation of the model did not include Drainage Pump Station (DPS) 07–DPS 12 drainage basins. The model was validated upstream in the DPS 01 drainage basin using high-water marks in the DPS 01 drainage area for a 12.6-inch storm in May 1995 and against flow monitoring data capturing two 7-inch storms in December of 2009. Model linksrepresent pipes, pumps, road conduits, or equalizer conduits. Model nodes are in the form of junctions (at the ends of pipes at least 15 inches in diameter, intersections of drainage systems, locations of pipe diameter change, and points representing the hydrologic unit low points), storage junctions, or outfalls. The report appendices consist of detailed data such as surveyed structures, flooded nodes and streets, manhole rehabilitation recommendations, and existing and proposed pipe diameters. The City of New Orleans Stormwater Management Capital Improvements Plan states:

> *"The results from the existing condition model runs indicate that most of the city does not currently meet the proposed level of service and that both the NO DPW and S&WB system need to be improved to meet the intended LOS goals. Over the city's modeled system, 42% of nodes showed flooding over six inches during the 10-year design storm, which equated to just under 600 miles of streets experiencing flooding greater than the desired levels" (CDM Smith, 2012)*

The Lakeview North and South areas are included in the DPS 07 and DPS 12 service areas. An example of capital improvement recommendations for DPS 07 and DPS 12 are seen in Figure 2-2, and the rest can be found in the Stormwater Management Capital Improvements Plan (CDM Smith, 2012). Each of these recommendations will be considered and detailed in the Task 3 Project Scoping and Scoring.

For the DPS 07 service area, the following improvements and findings were presented:

1. *One of the systems with significant size increases is the one that serves the Mid-City neighborhood from I-10 to Palmyra Street and Carrollton Avenue and further southeast near Jefferson Davis Parkway. Major pipe upgrades are need along multiple streets, including multiple blocks of Banks Street, to meet the proposed LOS. Six different streets would need new pipe to move water to the more efficient systems.*

2. *Significant size increases are expected to be needed in the Lakeview neighborhood on both sides of the Major S&WB system along Canal Boulevard, from West End Boulevard to Orleans Avenue. Most of the improvements are north of Harrison Avenue, although there will still need to be major improvements as far south as Polk Street. Major pipe upgrades are needed along many streets, including multiple blocks of new pipe.*

3. *A large number of new pipes have been added to the service area where none previously existed, primarily to connect separate systems and move water more efficiently.*

4. *There are a few locations in the service area where the proposed LOS could not be met, either because the boundary condition (top of the S&WB box) was higher than the street elevation (based on rim invert), or because the elevation of the low-lying area was very close to the HGL of the boundary condition and therefore the size of pipe necessary to meet the LOS was not deemed to be feasible. (CDM Smith, 2012)*

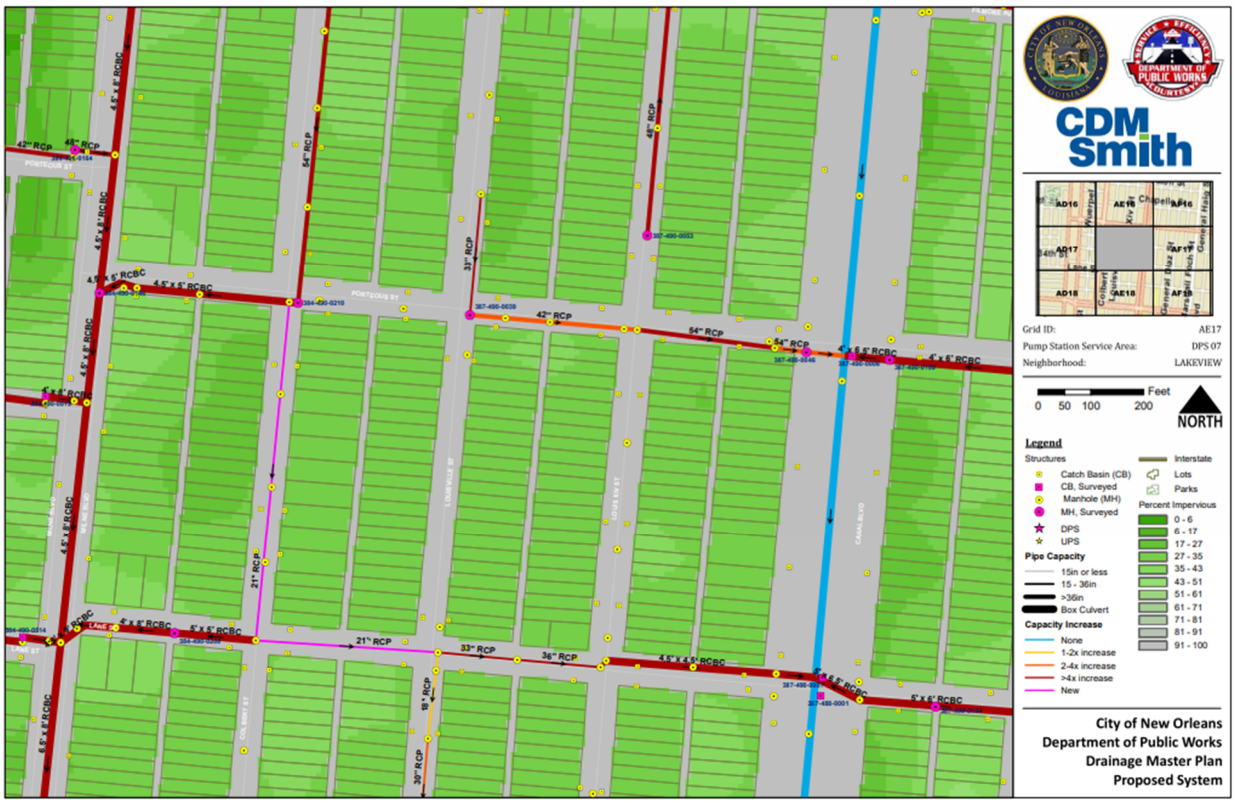
For the DPS 12 service area, the following improvements and findings were presented:

1. *In general, the major S&WB box culverts along [Allen Toussaint Boulevard] and Fleur De Lis Drive were not revised in this alternative solution.*

2. *In the Lakeshore – Lake Vista neighborhood, some larger increases are expected to be needed connecting Egret Street, Flamingo Street, and Dove Street to [Allen Toussaint Boulevard].*

3. *In the West End, between 32nd Street and 38th Street, many of the lines will need larger size increases than normal, although most of the West End needs some increase in pipe sizes. (CDM Smith, 2012)*

Figure 2-2 Stormwater Management Capital Improvement Plan, Sheet AE17, Central Part of the Lakeview Area (CDM Smith, 2012) – Example Proposed Improvements



2.2.2 Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems (SWBNO and BCG Engineering and Consulting, Inc., 2016)

The Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems (SWBNO and BCG Engineering and Consulting, Inc., 2016) presents the results of hydrologic and hydraulic modeling that was conducted with SWMM5 in the Lakeview and Mid-City areas of Orleans Parish. The model presents flooding that can be expected in 2-year, 5-year, 10-year, and 100-year theoretical 24-hour storms under existing drainage conditions The frequency based synthetic rainfall distributions from Orleans Parish are shown in Figure 2-3 and temporal based rainfall distributions provided in the National Weather Service Technical Papers Hydro-35 and No. 40.

Figure 2-3 Frequency Based Synthetic Rainfall Distributions for Orleans Parish (SWBNO and BCG Engineering and Consulting, Inc., 2016)

DURATION HOUR	FREQ. 2-YR	FREQ. 5-YR	FREQ. 10-YR	FREQ. 25-YR	FREQ. 50-YR	FREQ. 100-YR	FREQ. 500-YR
1	2.4	3.0	3.3	3.8	4.1	4.4	6.3
6	4.1	5.3	6.2	7.1	7.9	8.9	12.8
24	6.0	7.6	9.2	10.4	11.6	13.2	19.0

The hydraulic model was based on the CDM Smith (2012) SWMM5 input files with the incorporation of the storm drainage system and application of surface storage and flooding simulation. The storm drainage system consists of the following:

- **Primary system** – Larger than 60 inches in diameter
- **Secondary system** – 36 to 60 inches in diameter
- **Tertiary system** – less than 36 inches in diameter

The methodology section of the report identifies subcatchment parametrization such as area, slope, width, imperviousness, roughness, and infiltration. The pump curves of DPS 02, 07, and 12 were used to establish temporal based operating conditions. The topographical data source for the model is based on 2012 LIDAR. Ground truthing was done to determine the reliability of the LIDAR data. The average difference between 54 surveyed manhole covers and the LIDAR data was only 0.01 foot with a maximum difference of 0.43 foot.

Rainfall events that occurred on April 30, 2016, and May 1, 2016, were used as verification events. The rainfall depths that were used in the model were not included in the report. While observed data and model results were compared, the model was not successfully calibrated. Lack of model calibration was attributed to lack of data. The Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems (2016) report states:

"Since this event, at the 1st of May, 2016, three more water level gauges have been deployed on Argonne Blvd near the intersections with Filmore, Chappelle, and Mouton streets. However, at this writing no significant rainfalls have occurred that would further the efforts to calibrate the model. As a consequence, this effort is regarded as an interim calibration since the model does exhibit good reaction to rainfall but it is obvious that more observations are needed before acceptable calibration can be achieved". (SWBNO and BCG Engineering and Consulting, Inc., 2016)

The results section presents the following:

- Stage hydrographs for 10-year and 100-year events with and without surface storage added.
- An example of a water surface elevation profile against ground elevation.
- Flood inundation maps for 10-year and 100-year events.

2.2.3 Stormwater Master Plan (SWBNO, Ardurra and ILSI Engineering, 2022)

The Stormwater Master Plan (2022) was prepared for SWBNO by Ardurra and ILSI Engineering. H&H modeling of Orleans Parish was developed to propose drainage improvements for the Stormwater Master Plan. The model combined the minor drainage components developed for the CNO Department of Public Works in 2012 with the major drainage system (greater than or equal to 36") components developed for SWBNO (SWBNO and BCG Engineering and Consulting, Inc., 2016) into what is referred to as the Comprehensive SWMM5 Model.

The following list is a summary of the model. Further details can be found in Section 3.

- The model uses high-resolution LIDAR topographic data acquired in 2012 to compute the storage area curves and overflow mapping.
  - LIDAR horizontal resolution: 2x2 feet
  - LIDAR vertical accuracy: 0.3 foot

- Land use source data was derived from the previous model (CDM Smith, 2012).
- Soil data was downloaded from SSURGO in 2020.
- All subcatchment hydrologic parameters were taken from the 2016 SWBNO model.
- Twenty-four-hour design rainfalls were based on the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 and were applied to each model drainage basin for this study using SCS Type 3 rainfall distribution. A total rainfall of 8.3 inches for the 10-year event was applied to the DPS 07–12 drainage basin.
- Pump stations and their nominal pump capacity were discussed and are detailed in Section 3.3.3.

The preliminary results from the comprehensive model conveyed a significant increase in flooding, which was assessed as being unreasonable compared to what was observed for historic events. The model revisions included the following:

- Removal of virtual weirs
- Revision of model storage areas (adding storage nodes and accounting for storage in streets)
- Adjustment of invert elevations and conduit sizes based on SELA improvements

The flooding extents and depths of the validation events (May 18, 2018, and July 10, 2019) resulted in further changes in the model built, including the following:

- Second revision of storage areas
- Slope and width of subcatchments update
- Reduction of the roughness coefficients for the streets

2.3 Existing Data

The existing data collected to date is detailed in Appendix A and discussed in this section.

2.3.1 Existing Surveys

Batture, LLC, was subcontracted to provide survey data for major drainage structures. As an initial step, Batture provided data obtained during survey efforts for prior projects. Data within Batture's possession was limited to areas south of Allen Toussaint Boulevard and between West End Boulevard and Canal Boulevard, including:

- Lakeview Drainage Infrastructure and Green Infrastructure Planning with Spackman Mossop and Michaels (Survey points shown in See Figure 2-4.)
- DPW737 Milne
- SWBNO DPS survey
- SWBNO underpass and City Park survey

While beneficial for spot-checking the existing model, the data delivered was insufficient for the needs of the project. For example, part of the survey database could not be utilized because it did not contain drainage network details such as invert elevation and top of casting. To the extent practical, this data will be referenced during the model updates conducted as part of Task 2. For example, portions of the survey data contained georeferenced elevation data of surface features (ground, building finished floors, pavement, etc.).

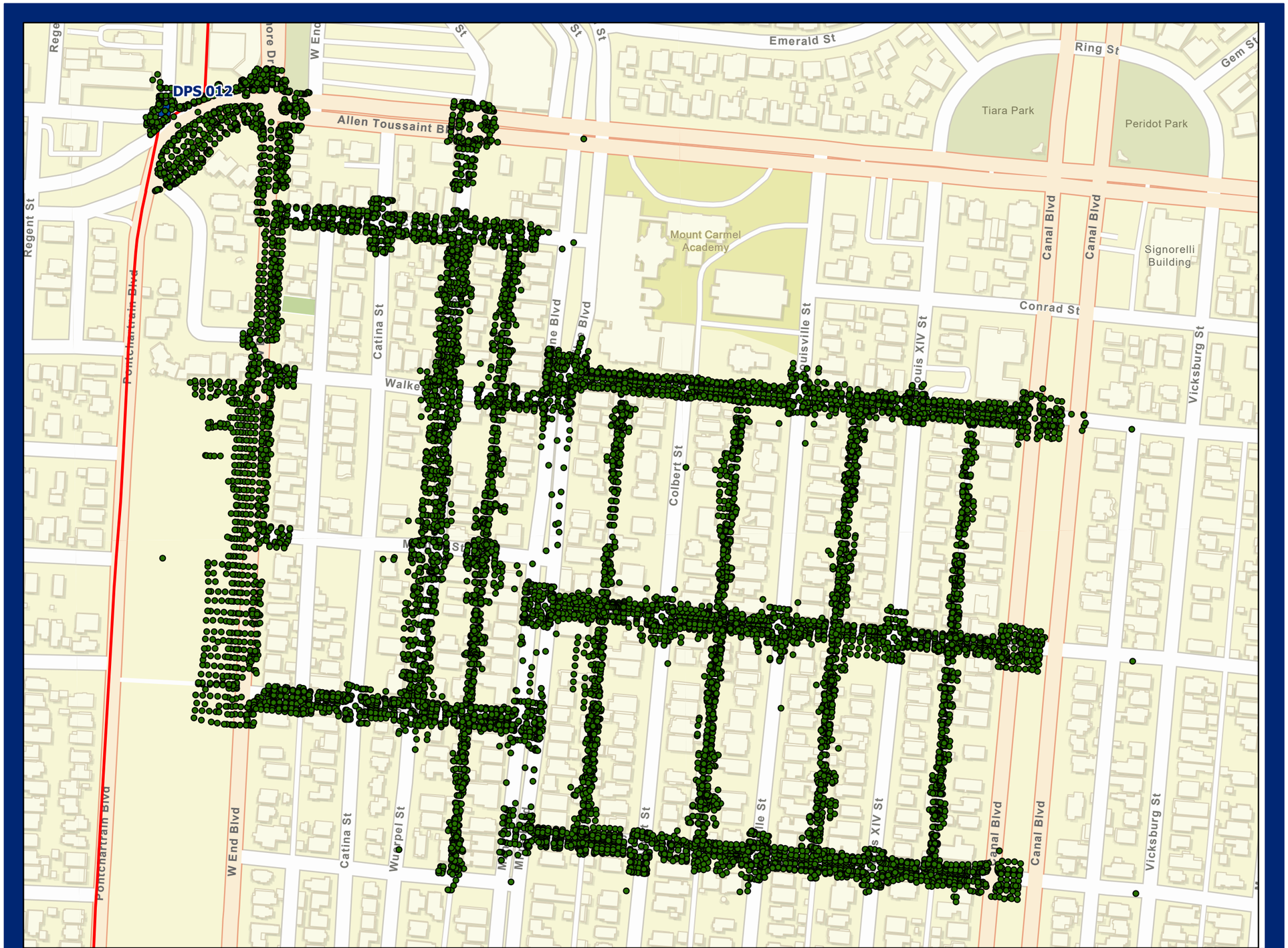


Figure 2-4:
Existing Survey Data
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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2.3.2 Existing Projects and Design

CNO provided drawings and as-builts for projects implemented through the Federal Emergency Management Agency's (FEMA) Recovery Roads program and City Capital Improvement Programs within the Lakeview area. This information proved valuable as it incorporates drainage updates executed during construction, includes survey points in certain submittals, and provides detailed information about roads. The designs, plans, and as-builts collected and referenced in the CNO project list are summarized in Table 2-1. Since several of these projects include drainage improvements, an optimal method for incorporating the existing projects and designs into the proposed conditions model will be determined in Task 3: Project Scoping and Scoring including Modeling Alternatives. Jacobs will coordinate with CNO to determine the baseline year on which the proposed model will be based.

Table 2-1 Existing Projects and Designs

Program	CNO Project ID	Project Name	Status	Anticipated Completion	Drawings Available
Drainage Improvements	DPW087	Homedale (Canal – West End), Center (33rd – Tacoma), Milne (Homedale – Florida), Walker Lakeview City Park Drainage Improvements	Bid & award Final design	Sept. 2025 Oct. 2023	No
Drainage Improvements	DPW737	Milne Blvd (Mouton – Allen Toussaint)	Planning	Apr. 2025	No
FEMA Recovery Roads	RR076	2019-RR076 Lake Vista Group D	Bid & award	Nov. 2024	Yes
FEMA Recovery Roads	RR077(1)	2019-RR077 Lake Vista Neighborhood Group E (FRC)	Merged projects	Jul. 2024	Yes
Capital Improvement	RR079	2019-RR079 Lakeshore Group B (PMOPC)	Preliminary design	Sep. 2025	Yes
FEMA Recovery Roads	RR081(2)	2019-RR080 & 2019-RR081 Lakeshore Group C_D 100% Submittal Plan and Profile Sheets	Merged projects	Jul. 2024	Yes
Capital Improvement	RR082	2020-RR082 Lakeshore Neighborhood Group E (FRC)	Bid & award	Jun. 2025	Yes
FEMA Recovery Roads	RR084	2019-RR084 Lakeview North Group B (PMO)	Final design	Sept. 2025	Yes
FEMA Recovery Roads	RR086	2020-RR086 Lakeview North Group D (FRC)	Bid & award	Aug. 2025	Yes
FEMA Recovery Roads	RR087	2019-RR087 Lakeview North Group E (FRC)	Construction	Nov. 2023	Yes
FEMA Recovery Roads	RR091	2017-RR091 Lakeview South Group B (FRCPI)	Bid & award	Dec. 2024	Yes

Program	CNO Project ID	Project Name	Status	Anticipated Completion	Drawings Available
FEMA Recovery Roads	RR222	2019-RR088 & 2019-RR089 Lakeview North Groups F and G	Merged projects	Jul. 2025	Yes

Notes

1) RR077 merged with Project RR075 under RR220
2) RR081 merged with Project RR080 under RR221

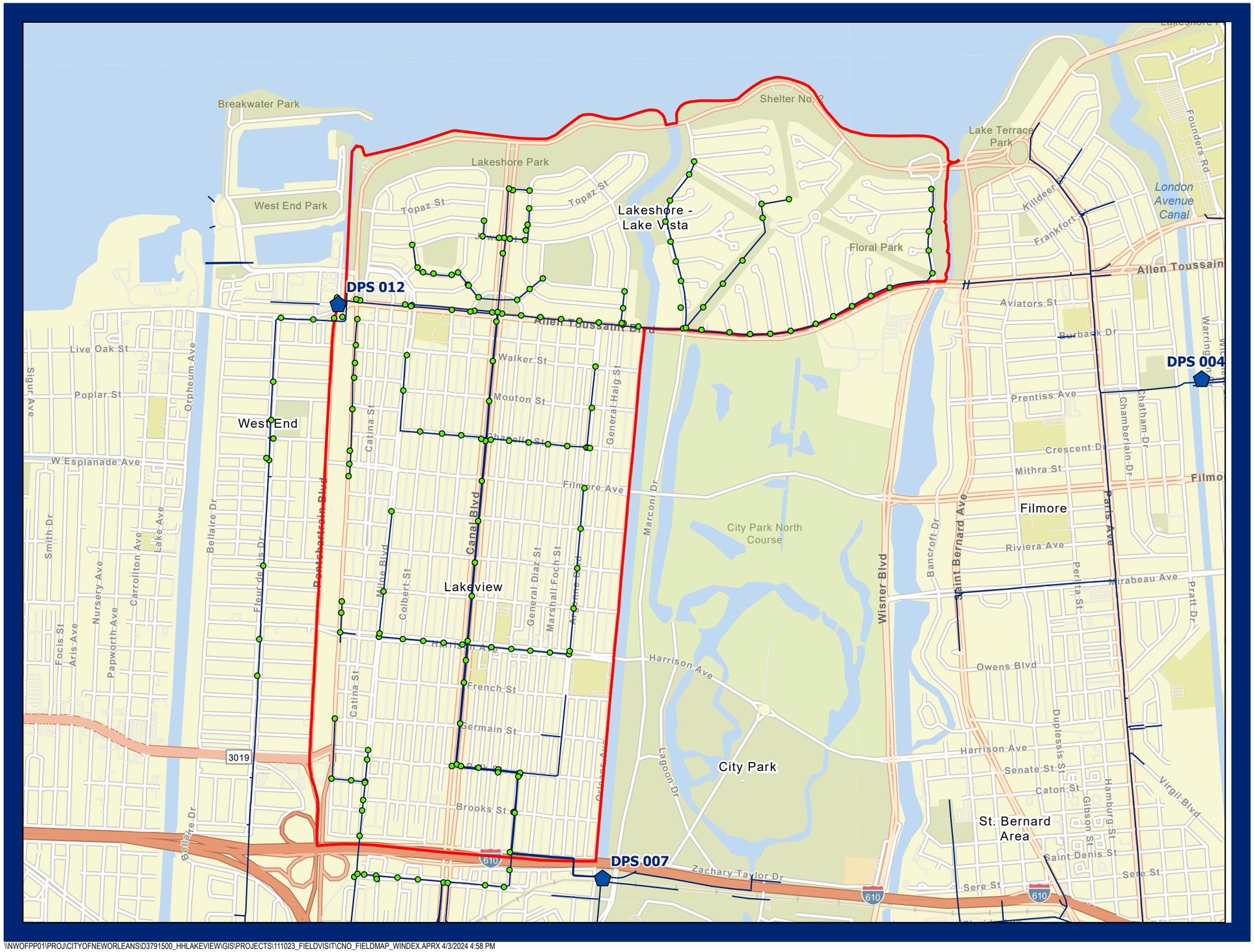
Most of these projects are anticipated to be completed in the future, and further consideration of their incorporation into the updated model will occur in Task 2. Projects that are currently in bid or construction phase will be included in the proposed or future conditions model developed as part of Task 3. .

2.3.3 Geospatial Data

Geographic information system (GIS) data for the project area was gathered from the CNO GIS open data portal and obtained directly from CNO. Additionally, CNO recently used Cyclomedia to acquire a substantial amount of GIS data within the project area. This collected data will play a crucial role in model development and the parameterization of Green Stormwater Infrastructure (GSI) suitability. Further specifics regarding the collected data can be found in the Data Log.

2.4 Infrastructure Survey

Batture, LLC, is currently undertaking a survey of significant drainage structures within the project area with the expected completion and submission of the final data to occur in March 2024. The task involves a field survey to pinpoint the locations, inverts, and pipe sizes of major drainage structures, specifically focusing on pipes and culverts with a diameter of 36 inches or more. The field survey is set to encompass up to 180 of these major drainage structures. Figure 2-5 shows the geospatial locations of the expected infrastructure survey.



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LEGEND

- Lakeview H&H Study Boundary
- Major Drainage Structures (>= 36")
- Drainage Pump Station
- Infrastructure Survey Data Points

0 0.13 0.25 0.5 Miles

Figure 2-5:
Infrastructure Survey
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

2.5 Model Validation Data

Due to lack of stage data for recent events, the current SWMM model has not been formally calibrated. It is understood, however, that the model was validated using high-water marks from the May 8, 1995, storm event provided by the Southeast Louisiana Orleans Parish Sections 533(D) report. This lack of calibration is discussed as a deficiency/limitation in the Stormwater Master Plan (SWBNO, 2022). A pilot study of calibration of the existing conditions model was completed for the combined DPS 02-03-04-19 model using data from May 18, 2018, and July 10, 2019. The area of the pilot study calibration is upstream of the Lakeview project area. A more detailed discussion of the validation/calibration efforts is found in the reports discussed in Section 2.2.

2.5.1 Rainfall Data

Preliminary rainfall data was requested from SWBNO SCADA system at the DPS for use in assessing storm events that may be suitable for calibration. The rainfall period and rainfall intervals provided at DPS near and in the Lakeview are shown in Table 2-2. Rainfall Validation data in the form of media and photos was collected for recent events, including September 4, 2023, and December 2, 2023.

Table 2-2 Rainfall Data Parameters

DPS	Rainfall Period	Interval
DPS 002	1/1/2019 – 1/31/24	1-hour
DPS 007	1/1/2019 – 1/31/24	24-hour; 1-hour; 15-minute
DPS 012	1/1/2019 – 1/31/24	1-hour
DPS I-10	1/1/2019 – 1/31/24	1-hour

2.5.2 Validation Data

In coordination with the Water Collaborative, CNO has contracted with ISeeChange, a company that specializes in collaborating with local communities to collect real-time observations of climate events like flooding and heat waves, to collect data within the Lakeview area that can be used for validation purposes. ISeeChange will coordinate the receipt and compilation of local submissions of flooding events that are expected to include dates, photos, and water level measurements.

3. Existing Conditions Model Review

3.1 Model Background

A detailed description of how the current PCSWMM model provided by CNO for this study was developed is provided in Section 4.1 of the Stormwater Master Plan prepared for SWBNO (Ardurra, ILSI, 2022). As described, H&H modeling for the New Orleans drainage system has been in development since the early 1980s, utilizing EPA-SWMM, XP-SWMM, the Hydrologic Engineering Center's River Analysis System, SWMM5, and most recently PCSWMM. At a high level, the resolution of this model has improved over the decades, as shown in the timeline in Figure 3-1.

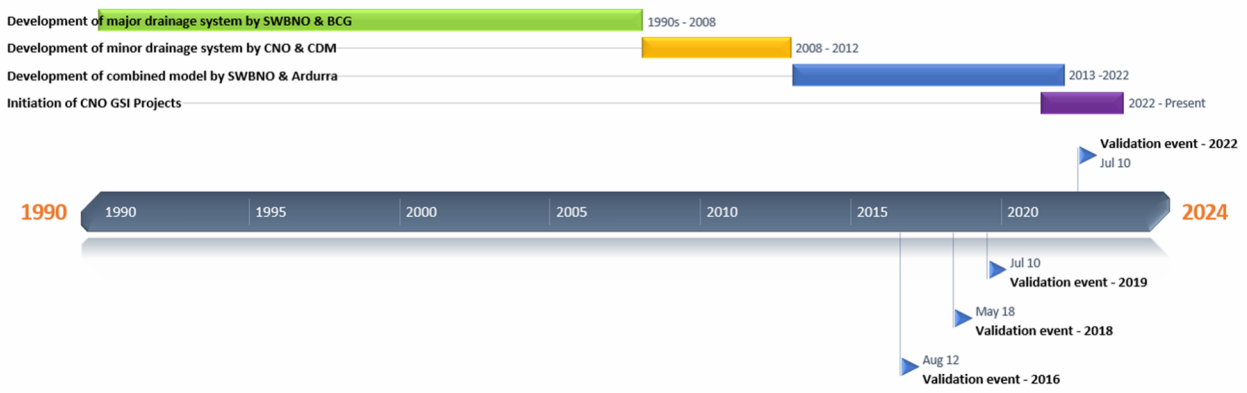
Originally, the models only represented the major drainage system components (i.e., large pipes, canals, and pump stations). These models were developed for the U.S. Army Corps of Engineers (USACE) as part of the Southeast Louisiana Flood Control Program and have been used to make recommendations for large-scale drainage improvements, including box culverts, canals, and pump station improvements.

In 2010, CNO developed a separate model of smaller drainage system components as part of a Capital Improvement Planning effort focused on reducing street flooding for up to a 10-year, 24-hour design storm. As certain limitations of the two separate models have been recognized, an effort has been underway since around 2012 to combine them into one comprehensive model representing all drainage system components.

The comprehensive model is the latest and best H&H modeling effort and serves as the basis for this study. Because of its scale, the comprehensive model was subdivided into service areas aligned with groups of DPS. The Lakeview area is within the model area associated with DPS 07–12.

To understand the model, it is important to consider the history of its development over the course of many years and different projects. Details of the model development pre-Katrina are thoroughly described in Section 4.1 of the Stormwater Water Master Plan (SWBNO, 2022).. Through the review of reports and discussion with previous model build teams, a timeline of the model development has been created (see Figure 3-1).

Figure 3-1 Timeline of Model Development



3.2 Model Parameterization

3.2.1 Terrain Data

The existing model's topographic data was developed using the USACE Hurricane and Storm Damage Risk Reduction System (HSDRRS) LIDAR collected by USACE in 2012 (OCM Partners, 2012)[1] The LIDAR elevation was taken in March 2012, and the combined DPS 07 and DPS 12 use this DEM. The output resolution of the 2012 DEM is 0.61 meter (2.0 feet), the horizontal datum is the State Plane Louisiana South NAD83, and the vertical datum is NAVD88.

A more recent DEM was developed using the Louisiana Department of Transportation and Development (LADOTD) LIDAR collected by the Sanborn Map Company, Inc in 2021 (OCM 2023)[2]. The 2021 DEM data was collected in November 2021 using the same horizontal and vertical datum as for the 2012 DEM. The 2021 DEM has a 0.5 m spatial resolution. The vertical accuracy of the 2021 DEM is 0.078 m for non-vegetated areas and 0.09 m for vegetated areas (Sanborn, 2022)[3], whereas for the 2012 DEM it is 0.06 m in open terrain (OCM Partners, 2021).

To better understand the terrain data in the model, a map comparing the 2012 and 2021 DEM was created as shown in Figure 3-2. Generally, the 2012 DEM has slightly higher elevation values than the 2021 DEM. In the Lakeview area, the 2021 DEM is higher than 2012 DEM more frequently in the central part of the project area, while the 2012 DEM higher than 2021 DEM in the northern part of the project area and within bodies of water.

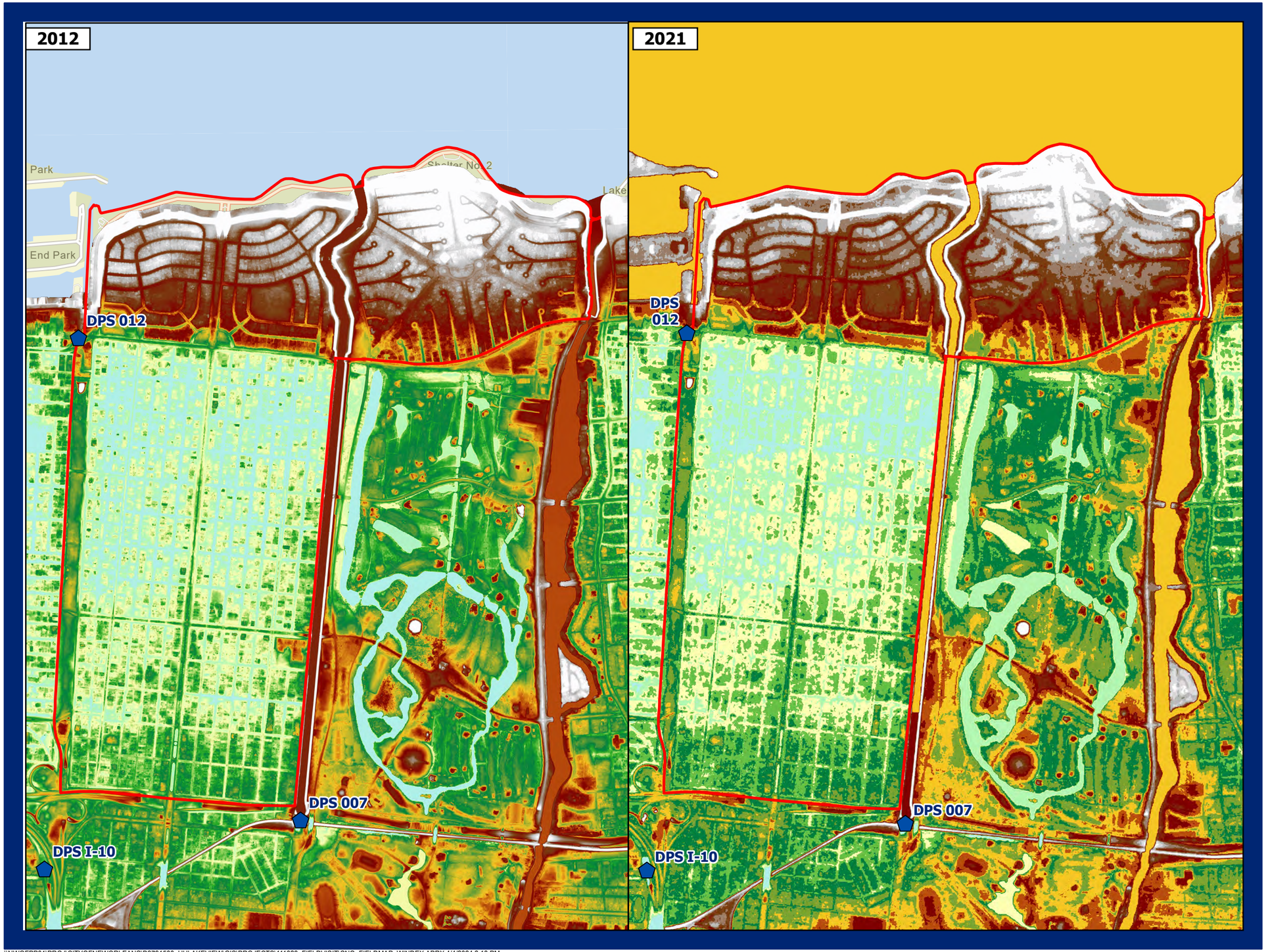
Figure 3-3 is a comparison of the 2012 and 2021 DEM along Lane Street. This comparison is consistent with general observations that the 2012 DEM is slightly higher than the 2021 DEM. Statistics for the map comparing the differences between the 2012 and 2021 DEMs are presented in Table 3-1. The table shows the minimum, maximum, range, mean, and standard deviation for the difference comparison, as well as a percentile. Most of the analyzed spots (pixels) have higher elevation values in the 2012 data than in the 2021 data.

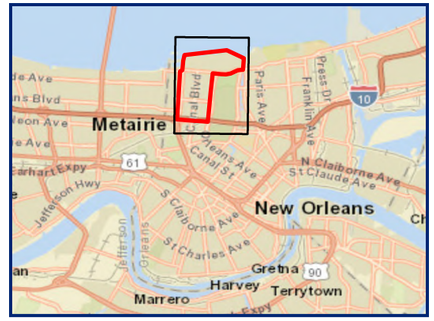
Recommendations for terrain data are found in Section 4.1.

[1] OCM Partners, 2012: 2012 USACE HSDRRS Lidar DEM: New Orleans, https://www.fisheries.noaa.gov/inport/item/49431.

[2] OCM Partners, 2021: 2021 LaDOTD Lidar: Greater New Orleans, LA, https://www.fisheries.noaa.gov/inport/item/70255.

[3] Sanborn Map Company, Inc, 2022: LADOTD New Orleans, LA Lidar 2021 312021420, https://rockyweb.usgs.gov/vdelivery/Datasets/Staged/Elevation/metadata/LA_2021GreaterNewOrleans_C22/LA_2021GNO_1_C22/reports/LADOTD_New_Orleans_Lidar_LidarMappingReport.pdf.





LEGEND

- Lakeview H&H Study Boundary
- Drainage Pump Station

DEM (feet)

28

-29

0 0.130.25 0.5 Miles

Figure 3-2:
DEM Comparison
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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Figure 3-3 Topography along Lane Street (Feet)

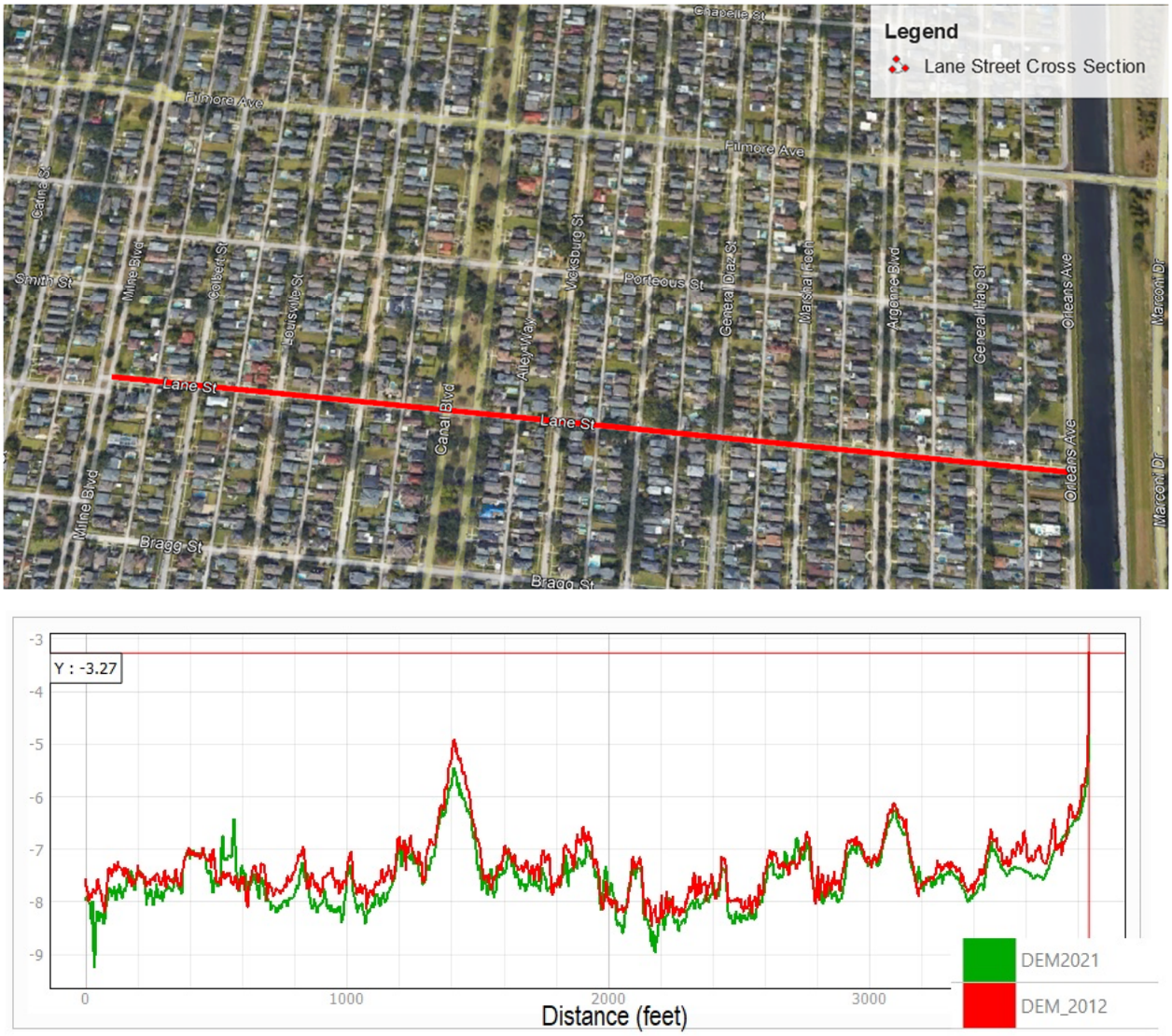

Table 3-1 DEM Comparison Statistics (Feet)

MIN	MAX	RANGE	MEAN	STD	10	25	50	75	90
-20.73	32.14	52.87	0.66	2.08	-0.35	-0.04	0.17	0.36	1.11

Notes: Negative values mean that the 2012 DEM value is lower than the 2021 value; STD = standard deviation

3.2.2 Flow Accumulation

Flow paths delineating the overland drainage routes are illustrated with arrows in Figure 3-4. Pump stations play a crucial role in controlling the final discharge of runoff in this region, directing it from DPS 02 to DPS 07 for outfall into Orleans Canal to Lake Pontchartrain and from DPS 12 for outfall directly into Lake Pontchartrain.

Figure 3-4:
Overview of Flow Paths
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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3.2.3 Land Use

Land use within the project area is predominantly characterized by developed urban areas consisting of single-family residences and commercial establishments. The Lakeview area has predominantly impervious and/or improved surfaces which limits infiltration and increases runoff volume.

3.2.4 Soil Type

The soil information in the existing model is derived from the NRCS SSURGO database as of September 2020. A recent examination of the most recent update available on the NRCS SSURGO website indicates that the soil characteristics have remained unchanged since the initial download in 2020. The soil types within the Lakeview Project Area are include Table 3-2 and shown in Figure 3-5.

Table 3-2 Lakeview NRCS SSURGO Soil Classifications Details

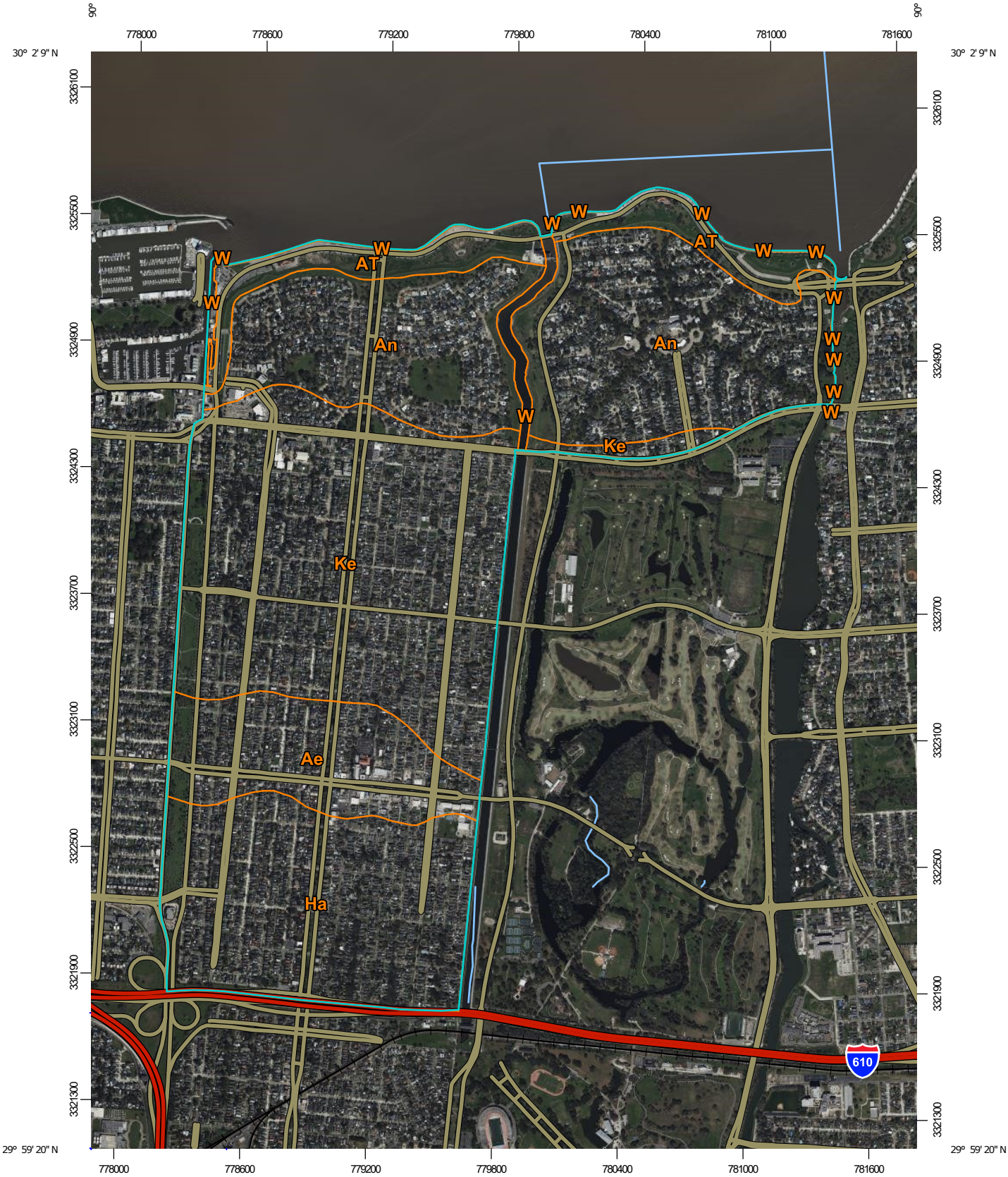
Soil Symbol	Soil Name	Slope (%)	Hydraulic Soil Group	Drainage Class
Ae	Allemands muck, drained	0 – 0.2	C	Poorly drained
An	Aquents, dredged	0 – 1	D[1]	Very poorly drained
AT	Aquents, dredged, frequently flooded	0 – 1	D[1]	Very poorly drained
Ha	Harahan clay	0 – 1	D	Poorly drained
Ke	Kenner muck drained	0 – 1	A	Poorly drained

Soil Survey Staff, Natural Resources Conservation Service, United States Department of Agriculture. Soil Survey Geographic (SSURGO) Database for Orleans Parish, Louisiana. https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx Accessed 2024.

1. Not directly stated in NCRS SSURGO database. NCRS – USDA Field Office Technical Guide states: "Poorly drained soils generally are in Group D because the high water table prevents movement of water in the soil" (NCRS – USDA, 2024).[4]

[4] Natural Resources Conservation Service, United States Department of Agriculture. Field Office Technical Guide. https://efotg.sc.egov.usda.gov/references/Delete/2017-11-11/hydrogroups.htm . Accessed 2024.

Soil Map—Orleans Parish, Louisiana
(Figure 3-5 NCRS SSURGO Soil Classification)



Map Scale: 1:25,400 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 350 700 1400 2100

Feet: 0 1000 2000 4000 6000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

USDA **Natural Resources Conservation Service**

Web Soil Survey
National Cooperative Soil Survey

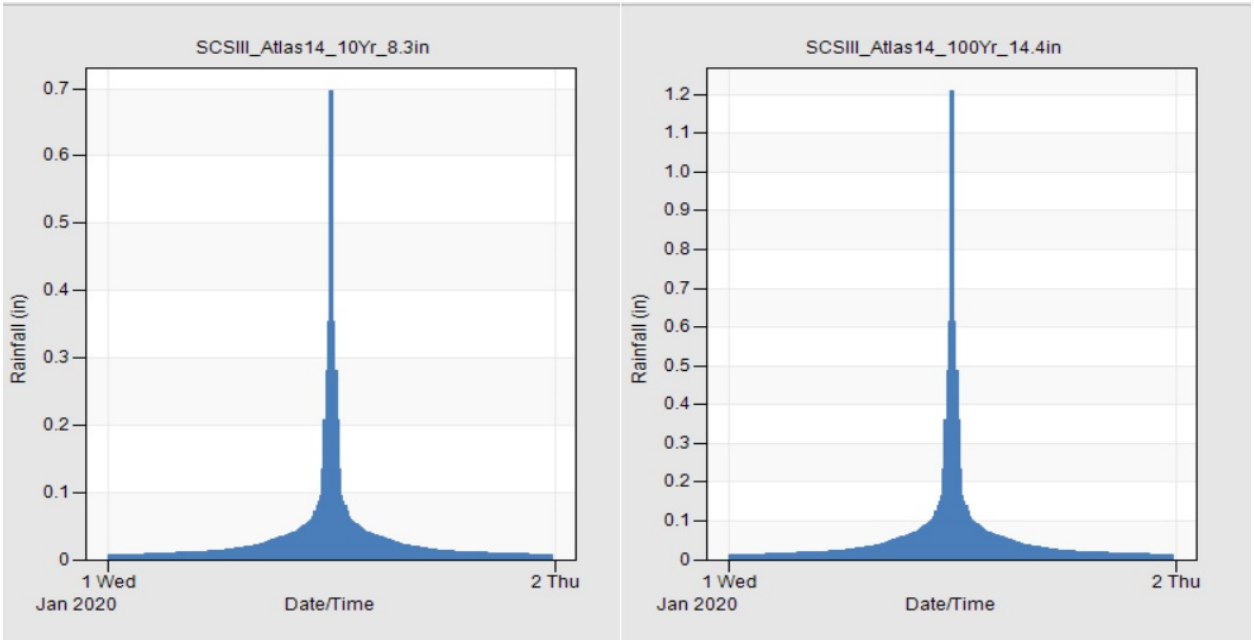
3.2.5 Rainfall

The existing model uses 24-hour design rainfall events based on the NOAA Atlas 14 (NOAA, 2018) with SCS Type 3 distributions. Rainfall was assigned for each DPS combined service area. Two rainfall time series were applied in the DPS 07 and DPS 12 combined models summarized in Table 3-3 and shown in Figure 3-6.

Table 3-3 Existing Conditions Model Total Rainfall

Event	Duration	Total Rainfall
10-year	24 hours	8.3 inches
100-year	24 hours	14.4 inches

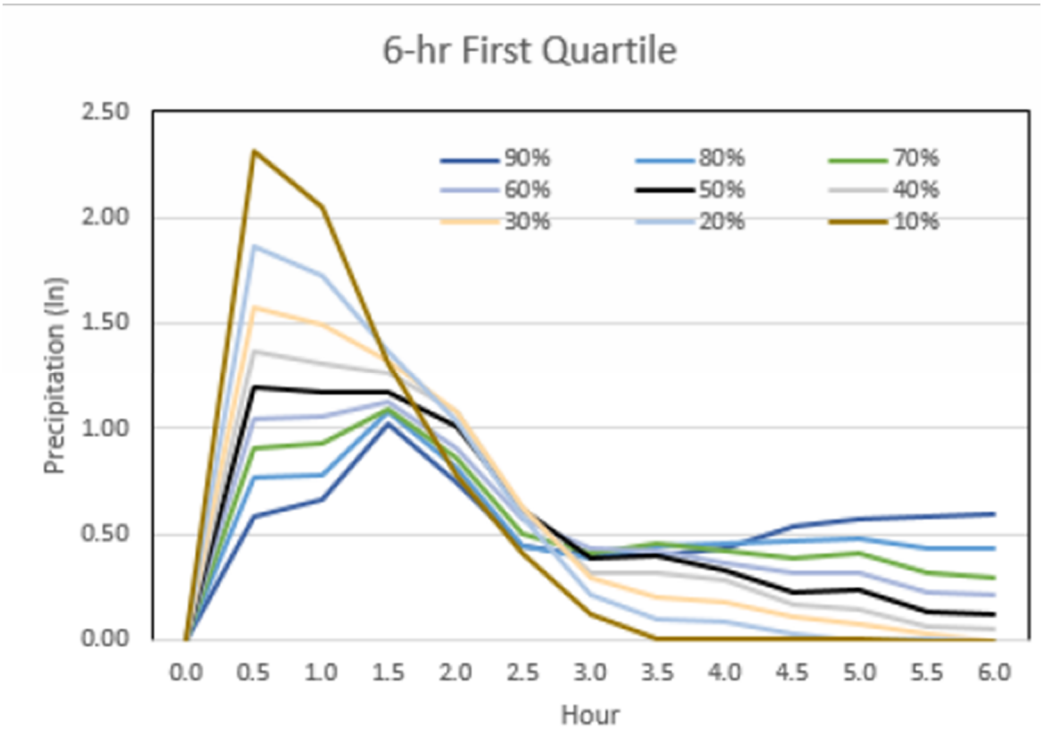
Figure 3-6 Existing Model Hyetographs



Based on the investigation conducted by Jacobs (as CH2M) during August 2017 Emergency Response for SWBNO, the design storm event distribution does not indicate a strain on the pumped system. The front-loaded distributions observed in the Atlas 14 Quartile 1 and 2 events were found to be more consistent with the rainfall data for the area. The Atlas 14 Quartiles 1 and 2 also indicate a strain on the pumped system due to the time necessary to activate the pumps. Examples of the Quartile 1 and 2 are included in Figure 3-7 and Figure 3-8, respectively. (CH2M and SWBNO, 2017)[5] Further discussion regarding the rainfall distribution to be utilized in modeling will be completed Task 2.

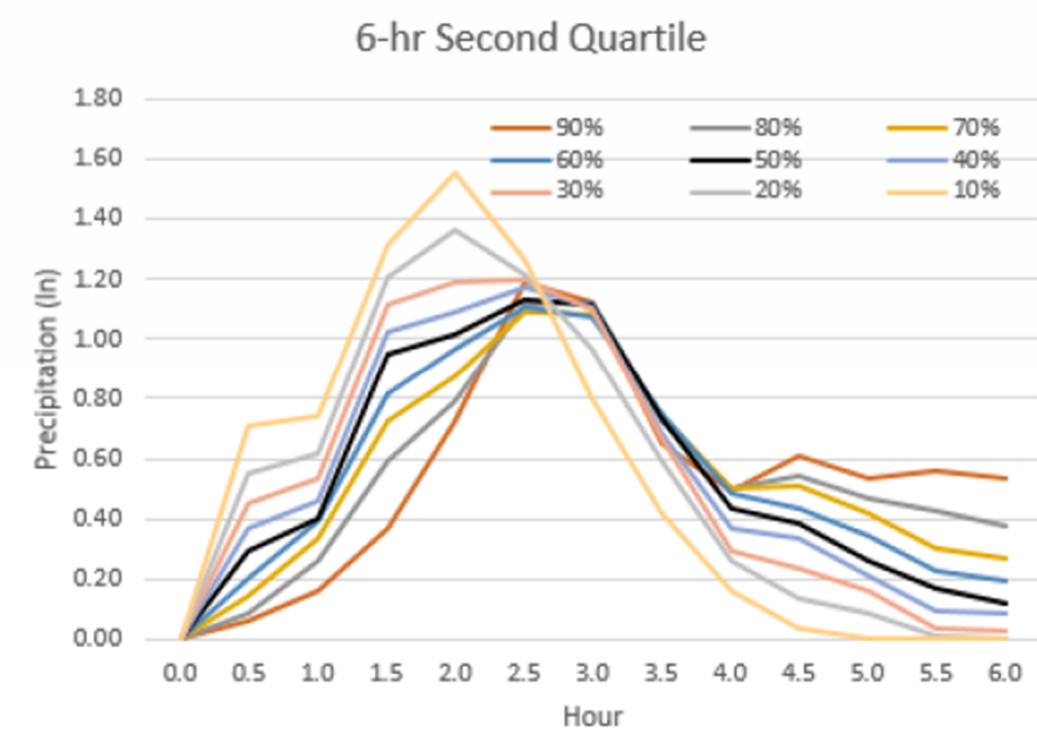
[5] CH2M and SWBNO, 2017. Gulf Coast Rainfall Distributions DRAFT. Published September 10, 2017.

Figure 3-7 NOAA Atlas 14 Quartile 1 Example



Note: Example uses 6-hour event with 7 inches of precipitation

Figure 3-8 NOAA Atlas 14 Quartile 2 Example



Note: Example uses 6-hour event with 7 inches of precipitation

The following is an example of how to interpret the results using the Figure 3-7 and Figure 3-8, for 6-hour first-quartile cases in the New Orleans. In 10% of the first-quartile cases, 62% of the total precipitation fell in the first 1 hour and 92% of the total precipitation fell by 2 hours. A median case of this type will drop half of the precipitation (50% on the y-axis) in approximately 1.5 hours. In 90% of the cases, 50% of the total precipitation fell by 3 hours and 90% of precipitation fell by 5.5 hours. (NOAA, 2013)[6]

3.3 Model Setup and Approach

This section contains a review of the current model setup, including a catalog of model elements, surface data, pipe data, and pump data. The catalog of model elements in the entire existing model and within the project area is detailed in Table 3-4. The Surface Data subsection discusses subcatchments and storage curves, and the Pump Data subsection analyzes and discusses the pumps and pump stations within the project area. The forthcoming Pipe Data subsection will be based on the final submission of the large infrastructure survey.

Table 3-4 Existing Model Elements

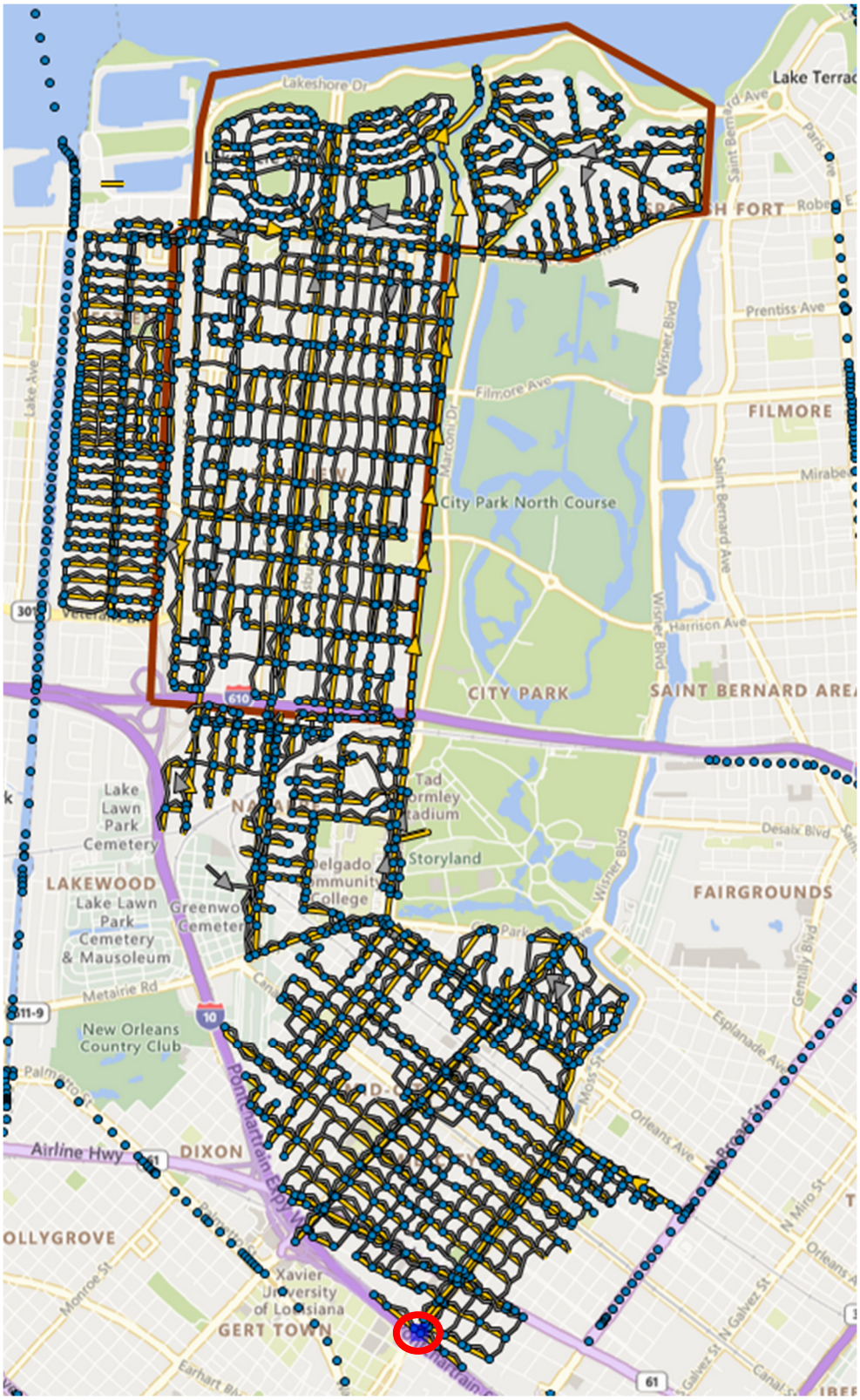
Model Element	Entire Existing Model	Project Area
Junctions	2,498	736
Conduits	5,920	2,102
Storage areas	338	133
Pumps	229 objects (20 inlet nodes/pump groups)	23 objects (3 inlet nodes/pump groups) DPS 07, DPS 12, P_OrleansICS-MWI15
Orifices	1	0
Subcatchments	1,120	468
Outfalls	10	0

3.3.1 Boundary Conditions

One node (DPS07_12998_CDM) has a time series applied. The name of the time series suggests a connection with Pump Station DPS 07, but the node is located significantly upstream (to the south) of the pump, so the inflow may have been connected to this model feature in error. If no information can be provided for this feature, and none has been received so far, then the time series at DPS07_12998_CDM will be removed for this project. The location of this node is shown in Figure 3-9.

[6] National Oceanic and Atmospheric Administration, 2013. NOAA Atlas 14 Precipitation-Frequency Atlas of the United States Volume 9 Version 2.0: Southeastern States (Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi).

Figure 3-9 Boundary Condition Node Location



Note: Location of node circled in red on diagram of the existing conditions model

3.3.2 Surface Data

The modeled area consists of subcatchments characterized by the following input parameters:

- Precipitation hyetographs
- Subcatchment area
- Slope
- Width
- Percent imperviousness
- Manning's roughness coefficient
- Depression storage
- Infiltration parameters

The existing comprehensive model created by Ardurra (see Section 2.2.3) uses storage areas widely throughout the model, though it should be noted that storage areas were not a significant feature of the 2012 CDM Smith model. A total of 132 subcatchments are connected to conduits by storage nodes within the Lakeview area. According to the Ardurra report, the storage area curves were computed using the 2012 LIDAR data and applied to the storage nodes using the same invert elevation as the junctions they replaced. The storage curves were revised to remove double counting of storage in street conduits. As reported by Ardurra in 2022, adjustment of the storage curves produced more reliable results in terms of calibration events investigated.

A comparison was conducted between maximum storage areas in the existing model within the Lakeview area and storage areas generated automatically based on subcatchment polygons and raw LIDAR data from 2012 and 2021. Generally, maximum areas for curves used in the existing model were higher than those generated based on 2012 and 2021 LIDAR data. This pattern implies greater storage in the model. Larger differences were observed for the vertical axis representing elevation. As curves within the existing model were adjusted by Ardurra to avoid double counting with the dual drainage network, the bottom sections of curves were changed and depths were updated. Examples of the existing storage curves, curves generated using 2012 LIDAR, and curves generated using 2021 LIDAR are shown in Figure 3-10, Figure 3-11, and Figure 3-12, respectively. Updates to surface are discussion in Section 4.1.

Figure 3-10 Existing Storage Curve Example

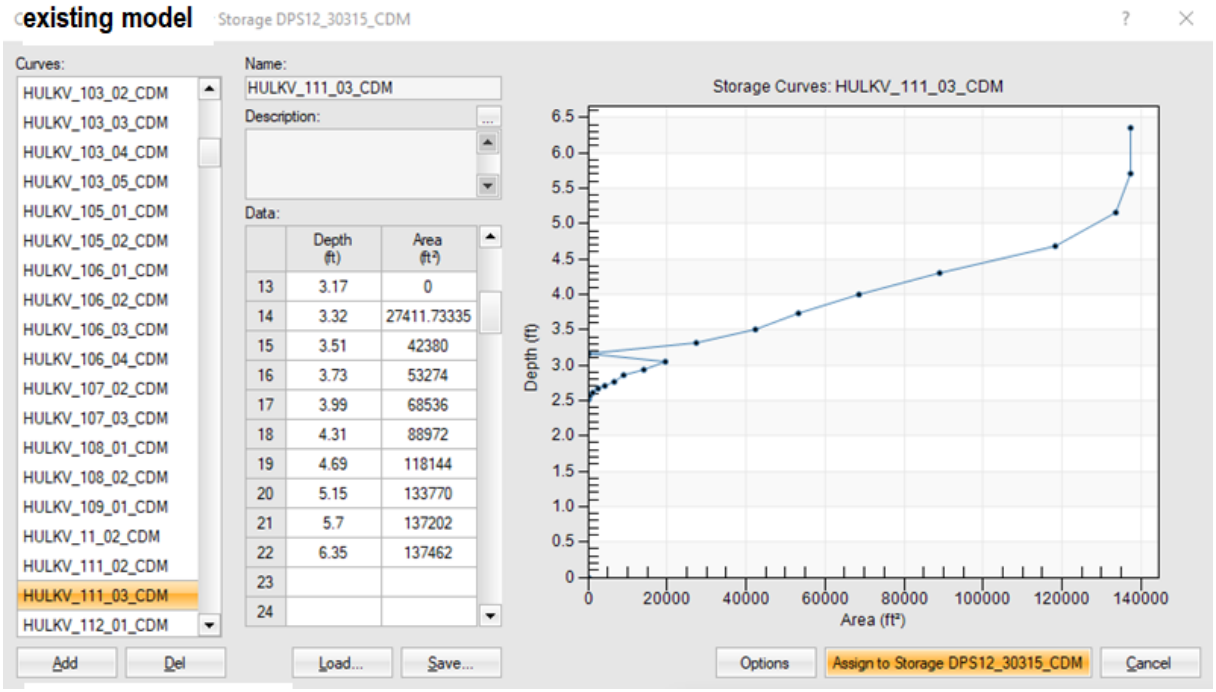


Figure 3-11 2012 LIDAR Storage Curve Example

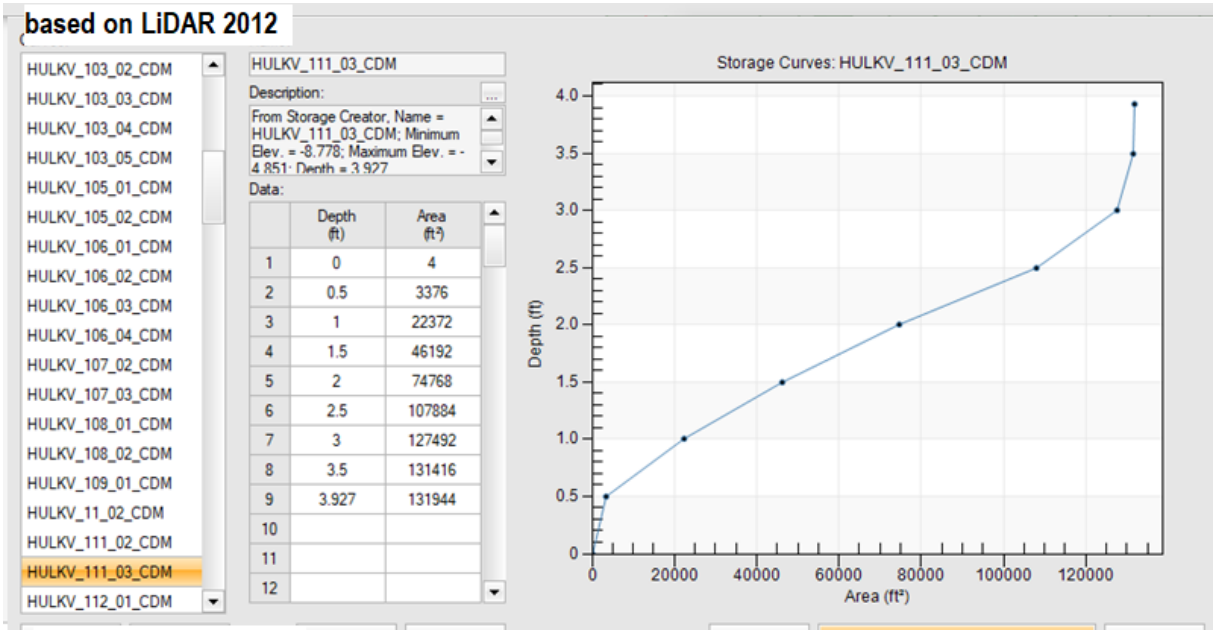
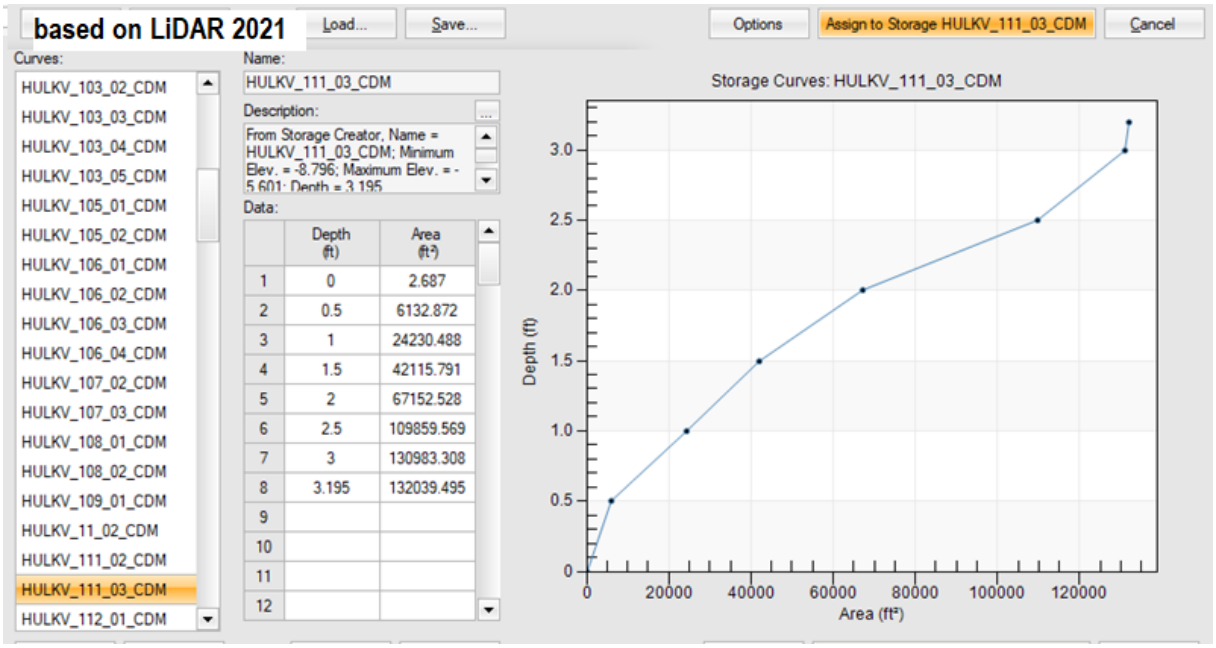


Figure 3-12 2021 LIDAR Storage Curve Example



3.3.3 Pump Data

Pump data for the existing model was provided by SWBNO and presented within the Ardurra report (SWBNO and Ardurra, 2022). The project area is located within the DPS 07 and DPS 12 service area and upstream of the DPS 02 service area. Pump parameters are presented in Table 3-5. A comparison of nominal flow capacity between SWBNO data and maximum pump flow capacity within the existing model

revealed some discrepancies. The most significant differences pertain to Pump Stations DPS 02 with max flow at 77% of capacity and DPS 07 with max flow at 74% of capacity, as shown in Table 3-5. Information regarding the reduction in pump capacity used in the model versus actual capacity has been requested from SWBNO and Ardurra. For the Orleans Parish 2016 Flood Insurance Study, pumping capacity of 90% was assumed at each pump station. This reduction in capacity accounts for potential issues that could occur during a storm event such as reduced power availability or inoperable pumps due to mechanical failures or physical obstructions.

Table 3-5 Pump Parameters According to SWBNO (*) and within the Existing Model (**)

Station ID*	Equipment Name*	Type of Pump*	Diameter (ft)*	Max Flow (cfs)*	Total Flow (cfs)*	Max Flow (cfs)**	Pump ID**
2	A	Large	12	550	3,150	1,321.31	DPS02a
2	B	Large	12	550			
2	C	Large	11	1,000		1,096.47	DPS02b
2	D	Large	11	1,000			
2	CD #2	Constant Duty	3.5	25			
2	CD #3	Constant Duty	3.5	25			
7	A	Large	12	550	2,690	2,002.88	DPS07
7	C	Large	14	1,000			
7	D	Large	14	1,000			
7	CD #1	Constant Duty	3	70			
7	CD #2	Constant Duty	3	70			
12	D	Large	14	1,000	1,000	1,063.9	DPS12

3.3.4 Pipe Data

Pipe data will be further evaluated in the TM 2: Existing Conditions Model after submittal of the survey.

4. Model Recommendations

More comprehensive flood inundation analysis modeling will be conducted in Task 2 to complement the Task 1 data collection and existing model review. The goal of this model review and data collection in Task 1 is to ascertain the data gaps and updates necessary for the existing conditions model. Following an extensive evaluation of the model, the recommendations for Task 2: Existing Conditions Model are described in the following subsections.

4.1 Surface Updates

As discussed in Section 3.3.1, the surface within the existing conditions model has a series of stage-storage relationships that were developed through iterations of historical model updates. The current parameters of the stage-storage updates do not have supporting documentation to determine the exact nature of the attributes.

To improve the representation of storage within the system, two approaches are currently under evaluation:

- Use of PCSWMM's dual drainage tools and conversion to a combined 1D / 2D model where a 2D mesh would be used to represent both storage within the streets, lots, and open areas. In either case, the current storage nodes will be removed.

If dual drainage is selected, all existing conduits representing streets will be removed and updated using the PCSWMM dual drainage tool. New conduits representing streets will be generated parallel to all major and minor system conduits. This dual drainage tool is expected to better represent the storage associated with the street itself as well as the area behind the curb and into the lots as compared to the generic cross section applied to street conduits in the current model. Different street cross sections will be developed for major and minor streets and applied accordingly.

If storage nodes are determined to be needed, they will be developed based on 2021 LiDAR.

4.2 Pipe Updates

The pipe network updates will be based on the latest set of survey data. The data sources discussed in Section 2.3.1 and 2.3.2 will be referenced as well during this process.

4.3 Pump Updates

The pump stations will remain as currently input in the model. Information regarding the difference in pump station capacity between the model and the Stormwater Master Plan (SWBNO, 2022) has been requested from SWBNO and Ardurra. The model reflects a decreased flow that is approximately 75% of the nameplate flow of the pumps. It is assumed that this reduced capacity is due to a FEMA guideline. SWBNO/Ardurra have been contacted to confirm this assumption, and the path forward may be adjusted based on response.

- If this assumption is correct, pump stations will remain as currently input in the model.
- If this assumption is not correct, pump stations will be adjusted to reflect nameplate flows.

4.4 Calibration/Validation Updates

The updated model will be validated using storm events previously identified and validation data collected after recent events. Up to three events will be used for validation following consultation with CNO. Table 4-1 is a list of current targeted events for validation.

Table 4-1 Rainfall Events Targeted for Validation

Event	Depth Observed at DPS 007	Duration	Frequency
August 29, 2021	6.67	24 hour	~5-year, 24-hour event
September 4, 2023	7.39	5 hour	~25-year, 6-hour event
December 2, 2023	6.76	30 hour	~5-year, 24-hour event

1. Durations rounded to nearest hour

APPENDIX A. DATA LOG

No	Source / Author	Category	Type	Description	Comments	Revelance
1	USACE	Existing Model	1D HEC-RAS Model	USACE HEC-RAS Model	Requested, but not yet received	Model used for comparison to project model
2	CNO OSR	Existing Model	1D PC SWMM	Existing Conditions Model	1D hydraulic model prepared for 10- and 100-yr event in PCSWMM	Model used for project development
3	Batture LLC	Existing Model	1D PC SWMM	City Park Model		Model interacts with project boundary
4	CNO OSR	Existing Model	Map	Lakeview H&H Revised Map		Project boundary
5	CNO OSR	Documentation and Studies	Excel	Project List		Identifies CNO design and construction projects within the project area
6	CNO	Documentation and Studies	Map	2020 Drainage Map - 04 West End	2014 Adjusted Drainage System (Rubber-sheeted Drainage Lines and Drainage Structures). Approximate location/work as schematic diagram of system—not to same accuracy as the Cyclomedia-derived base data sets. Made for/by contractor for a previous drainage study.	Drainge map relative to project area
7	CNO	Documentation and Studies	Map	2020 Drainage Map - 05 UNO	See comment in Line Item 14	Drainge map relative to project area
8	CNO	Documentation and Studies	Map	2020 Drainage Map - 11 Lakeview North	See comment in Line Item 14	Drainge map relative to project area
9	CNO	Documentation and Studies	Map	2020 Drainage Map - 17 Lakeview South	See comment in Line Item 14	Drainge map relative to project area
10	CH2M (Now Jacobs)	Documentation and Studies	Map	Flood Depth for Expected TS Harvey (preliminary draft)		Drainge map of historical event relative to project area and to be used for validation
11	CNO and Deltares	Documentation and Studies	Report	Assessment of Land Subsidence in New Orleans	Dated May 2023	Detailing the variability of subsidence in the greater New Orleans area
12	SWBNO and BCG Engineering & Consulting	Documentation and Studies	Report	Engineering Investigation of Lakeview & Mid-City Basing Drainage Systems	Dated July 2016	Discussed in Section 2.2.2
13	CNO and Deltares	Documentation and Studies	Report	Monitoring Water and the Urban Environment (Draft)	Dated May 2023	Details proposed monitoring network of groundwater, surface water, and subsidence. Once monitors are implemented, they could be used for further calibration.

APPENDIX A. DATA LOG

No	Source / Author	Category	Type	Description	Comments	Revelance
14	CDM Smith	Documentation and Studies	Report	The City of New Orleans Stormwater Management Capital Improvements Plan	Dated 2012	Discussed in Section 2.2.1
15	Ardurra and ILSI Engineering	Documentation and Studies	Report	Stormwater Master Plan	Dated 2022	Discussed in Section 2.2.3
16	ABS Group	Documentation and Studies	Report	City of New Orleans Stormwater Drainage System Root Cause Analysis Final Report	Dated October 2018	Root cause analysis of Summer 2017 flood events.
17	Personal Photos	Calibration Data	Historical Flooding	Historical Event Photos and Videos (9/4/2023)		Evidence of flooding events
18	CNO	Calibration Data	Historical Flooding	Historical Event Video (December 10, 2022)	Catch basins on Marshal Foch between Walker and Chapelle	Evidence of flooding events
19	CNO	Calibration Data	Historical Flooding	Historical Event (August 28, 2022)	6500 Block of Memphis, report of pumps not working	Evidence of flooding events
20	CNO	Calibration Data	Historical Flooding	Historical Event (August 28, 2022)	6500 Block of Memphis	Evidence of flooding events
21	CNO	Calibration Data	Historical Flooding	Historical Event (July 8, 2023)	6500 block of Memphis and 6500 block of Louis XIV	Evidence of flooding events
22	CNO OSR	Model Calibration Data	Outlook File	Residential Complaints		Complaints within the project area
23	Batture LLC	Survey	.TXT	SWBNO Lakeview		Discussed in 2.4.1
24	Batture LLC	Survey	CAD	Spackman Mossop Micheals – Lakeview Green Infrastructure		Discussed in 2.4.1
25	Batture LLC	Survey	CAD	Underpass- City Park		Discussed in 2.4.1
26	Batture LLC	Survey	PDF	Infrastructure Field Survey		Discussed in 2.4.1
27	Batture LLC	Survey	PDF, CAD	Survey- DPW 737 Milne Blvd		Discussed in 2.4.1
28	CNO OSR	Existing Projects and Design	Drawings	2019-RR076 Lake Vista Group D	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
29	CNO OSR	Existing Projects and Design	Drawings	2019-RR084 Lakeview North Group B (PMO)	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
30	CNO OSR	Existing Projects and Design	Drawings	2020-RR086 Lakeview North Group D (FRC)	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
31	CNO OSR	Existing Projects and Design	Drawings	2019-RR087 Lakeview North Group E (FRC)	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
32	CNO OSR	Existing Projects and Design	Drawings	2017-RR091 Lakeview South Group B (FRCPI)	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
33	CNO OSR	Existing Projects and Design	Drawings	2019-RR088 & 2019-RR089 Lakeview North Group F and G	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans

APPENDIX A. DATA LOG

No	Source / Author	Category	Type	Description	Comments	Revelance
34	CNO OSR	Existing Projects and Design	Drawings	2019-RR080 & 2019-RR081 Lakeshore Group C_D 100% Submittal Plan and Profile Sheets	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
35	CNO OSR	Existing Projects and Design	Drawings	2019-RR077 Lake Vista Neighborhood Group E (FRC)	FEMA Recovery Roads Program	Includes construction details, drainage details and survey within plans
36	CNO OSR	Existing Projects and Design	Drawings	2019-RR079 Lakeshore Group B (PMOPC)	Capital Improvement Program	Includes construction details, drainage details and survey within plans
37	CNO OSR	Existing Projects and Design	Drawings	2020-RR082 Lakeshore Neighborhood Group E (FRC)	Capital Improvement Program	Includes construction details, drainage details and survey within plans
38	CNO	Existing Projects and Design	Road Work	Lakeview North (RR083 - RR089) Neighborhood Map		Map of on-going and completed Roadwork in the Lakeview area
39	CNO	Existing Projects and Design	Road Work	Lakeview South (RR090/RR091) Neighborhood Map		Map of on-going and completed Roadwork in the Lakeview area
40	United States Geological Survey	Geospatial Data	Raster	DTM 0.5 meter	0.5-meter DEM, Downloaded from USGS LidarExplorer, data collected in 2021	GIS data to use for GSI evaulation and model updates, as suitable
41	CNO	Geospatial Data	Shapefile	Catch Basins (Cyclomedia/DPW)		GIS data to use for GSI evaulation and model updates, as suitable
42	CNO	Geospatial Data	Shapefile	Manholes (Cyclomedia)	point layer	GIS data to use for GSI evaulation and model updates, as suitable
43	CNO	Geospatial Data	Shapefile	Pavement Edge (Cyclomedia)		GIS data to use for GSI evaulation and model updates, as suitable
44	CNO	Geospatial Data	Shapefile	Sidewalks (Cyclomedia)		GIS data to use for GSI evaulation and model updates, as suitable
45	CNO	Geospatial Data	Shapefile	DPW Centerline		GIS data to use for GSI evaulation and model updates, as suitable
46	CNO	Geospatial Data	Shapefile	Studies Bounds		GIS data to use for GSI evaulation and model updates, as suitable
47	CNO	Geospatial Data	Shapefile	DPW/CNO Structures/Buildings		GIS data to use for GSI evaulation and model updates, as suitable
48	CNO	Geospatial Data	Shapefile	Building Footprint	two files, appear the to be the same	GIS data to use for GSI evaulation and model updates, as suitable
49	CNO	Geospatial Data	Shapefile	Catch Basin Locations		GIS data to use for GSI evaulation and model updates, as suitable
50	CNO	Geospatial Data	Shapefile	Road Centerlines	two centerline files, almost identical but slightly offset	GIS data to use for GSI evaulation and model updates, as suitable

APPENDIX A. DATA LOG

No	Source / Author	Category	Type	Description	Comments	Revelance
51	CNO	Geospatial Data	Shapefile	City Council Districts		GIS data to use for GSI evaulation and model updates, as suitable
52	CNO	Geospatial Data	Shapefile	Department of Public Works Roadwork Projects		GIS data to use for GSI evaulation and model updates, as suitable
53	CNO	Geospatial Data	Shapefile	Future Land Use		GIS data to use for GSI evaulation and model updates, as suitable
54	CNO	Geospatial Data	Shapefile	HDLC Landmarks		GIS data to use for GSI evaulation and model updates, as suitable
55	CNO	Geospatial Data	Shapefile	Historical Zoning	Pre 2015	GIS data to use for GSI evaulation and model updates, as suitable
56	CNO	Geospatial Data	Shapefile	Neighborhood Conservation Districts		GIS data to use for GSI evaulation and model updates, as suitable
57	CNO	Geospatial Data	Shapefile	New Orleans Parish Waterways		GIS data to use for GSI evaulation and model updates, as suitable
58	CNO	Geospatial Data	Shapefile	Parcels		GIS data to use for GSI evaulation and model updates, as suitable
59	CNO	Geospatial Data	Shapefile	Sewerage and Water Board Roadwork Projects	sewer, water, and drainage line repairs	GIS data to use for GSI evaulation and model updates, as suitable
60	CNO	Geospatial Data	Shapefile	Tree Locations	is in data viewer, not shapefile	GIS data to use for GSI evaulation and model updates, as suitable
61	CNO	Geospatial Data	Shapefile	Overlay	includes zoning disrict information	GIS data to use for GSI evaulation and model updates, as suitable
62	SWBNO	Geospatial Data	Shapefile	Pump Stations		GIS data to use for GSI evaulation and model updates, as suitable
63	CNO	Geospatial Data	Shapefile	2014 Rubbersheet Phase lll Drain ines and structures		GIS data to use for GSI evaulation and model updates, as suitable
64	SWBNO	Geospatial Data	Shapefile	SWB Electric Feeder Routes, SW Canals and Historical Drainage Tributary Areas		GIS data to use for GSI evaulation and model updates, as suitable
65	SWBNO	Rainfall	Excel	DPS 002 Rainfall Data	2019 - 2024 Rainfall data in 1-hour intervals	Historic rainfall to be used for model validation
66	SWBNO	Rainfall	Excel	DPS 007 Rainfall Data	2019 - 2024 Rainfall data in 15-minute, 1-hour, 24-hour intervals	Historic rainfall to be used for model validation
67	SWBNO	Rainfall	Excel	DPS 012 Rainfall Data	2019 - 2024 Rainfall data in 1-hour intervals	Historic rainfall to be used for model validation
68	SWBNO	Rainfall	Excel	DPS I-10 Rainfall Data	2019 - 2024 Rainfall data in 1-hour intervals	Historic rainfall to be used for model validation

APPENDIX A. DATA LOG

No	Source / Author	Category	Type	Description	Comments	Revelance
69	USACE	Terrain	Raster	2012 USACE HSDRRS Lidar DEM	OCM Partners, 2024: 2012 USACE HSDRRS Lidar DEM: New Orleans, https://www.fisheries.noaa.gov/inport/item/49431.	USACE HSDRRS DEM used to develop existing model topographic data
70	Louisiana LiDAR Project	Terrain	Raster and .csv	DTM 5 meter	OCM Partners, 2021: 2021 LaDOTD Lidar: Greater New Orleans, LA, https://www.fisheries.noaa.gov/inport/item/70255.	5-meter DEM, DTM does not fully cover the area of the model, data collected in 2002 and 2003. Data has been edited
71	Sanborn Map Company, Inc	Terrain	Report	LADOTD New Orleans, LA Lidar 2021 312021420	Sanborn Map Company, Inc, 2022: LADOTD New Orleans, LA Lidar 2021 312021420, https://rockyweb.usgs.gov/vdelivery/Datasets/Staged/Elevation/metadata/LA_2021GreaterNewOrleans_C22/LA_2021GNO_1_C22/reports/LADOTD_New_Orleans_Lidar_LidarMappingReport.pdf	Documentation regarding the 2021 Lousiana LiDAR Project data
72	Watersheds Concepts	Terrain	Shapefile	Breaklines		Breaklines derived from 5 meter Louisiana LiDAR Project DTM
73	Louisiana LiDAR Project	Terrain	Shapefile	Contours		2-foot interval contours derived from 5-meter Loiusiana LiDAR Project DTM

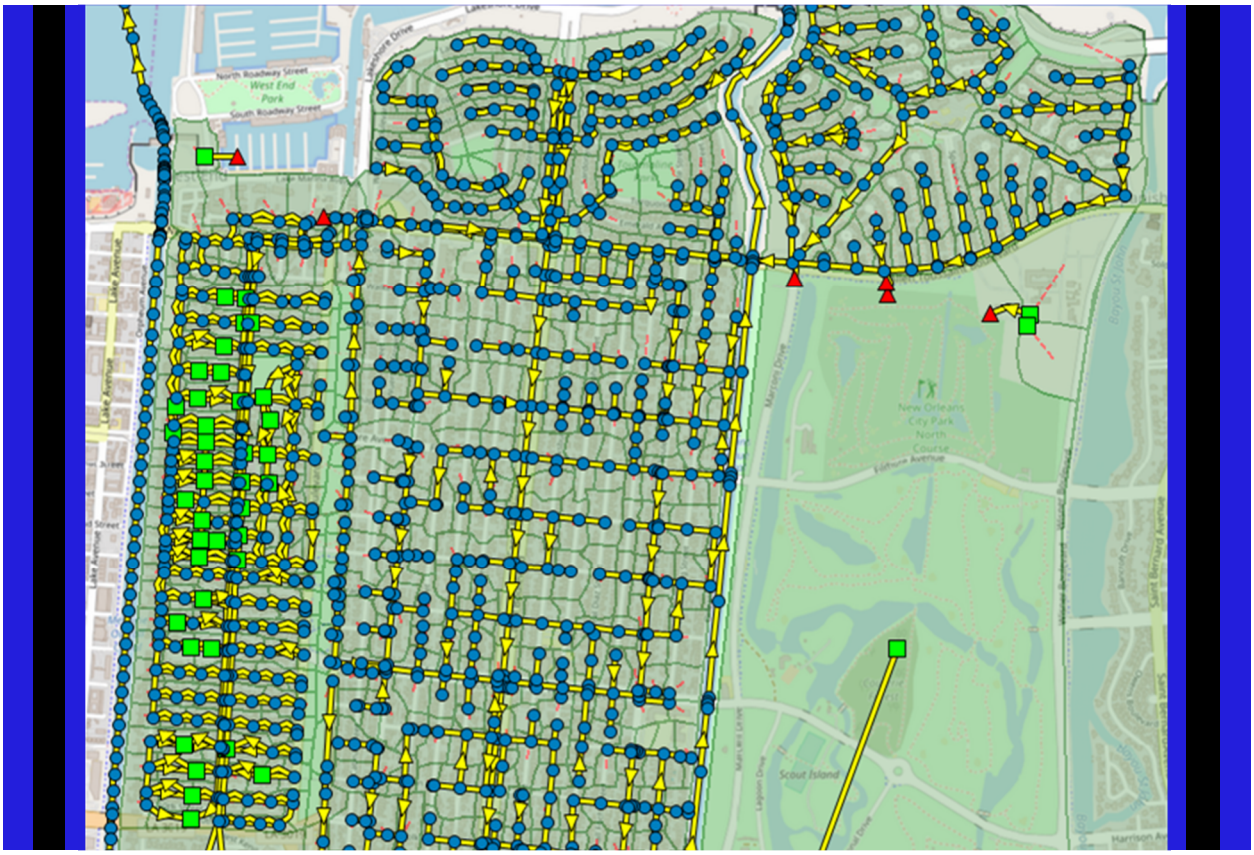
Appendix B. Task 2 – Existing Conditions Model Technical Memo

Task 2: Existing Conditions Model Technical Memorandum - Final

Document no: D3791500_TM2
Version: 2

The City of New Orleans
DPW 724 / K23-196

Hydrological and Hydraulic Drainage Study – Lakeview N & S
December 31, 2024



Task 2: Existing Conditions Model Technical Memorandum - Final

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Project name:	Hydrological and Hydraulic Drainage Study – Lakeview N & S		
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1. Introduction

1.1. Study Background

The Lakeview neighborhood is situated in the northern part of New Orleans. It is bordered by Lake Pontchartrain to the north, 17th Street Canal to the west, City Park to the east, and interstate I-610 to the south. The natural topography of New Orleans and subsequently Lakeview, below sea level, and the sinking soils, provide an increased risk of flood in the Lakeview Neighborhood. The Lakeview neighborhood is served by Drainage Pump Station (DPS) DPS-12, north of Harrison Street, and DPS-07, south of Harrison Street. The conveyance system drains to the box culverts below Canal Boulevard, West End Boulevard, and Allen Toussaint Boulevard, which drain to the DPS. Historically, the Lakeview neighborhood has frequently suffered from flooding. The city's minor drainage system is sized to a 10-year event, and the Lakeview neighborhood often observes flooding and standing water during storm events. Figure 1-1 and Figure 1-2 show photos taken during recent storm events, collected by both Jacobs team and Lakeview residents.

Due to the propensity for flooding, The City of New Orleans (CNO) contracted with Jacobs Engineering Group, Inc. (Jacobs) to prepare a comprehensive hydrologic and hydraulic (H&H) drainage study for the Lakeview North and South (Lakeview) neighborhood. The project area is shown in Figure 1-3. The study includes a survey of major drainage structures (>36 inches), updates and improvements to the City's existing Personal Computer Storm Water Management Model (PCSWMM) of the area, conceptual design work, and development of a prioritized list of drainage improvements, including a suite of both green stormwater infrastructure measures and gray infrastructure improvements to reduce flood risk and enhance the performance of the drainage system. This study will advance the City's Living with Water Plan and Greater New Orleans Urban Water Plan by moving from general concepts of promoting infiltration and storage of stormwater runoff to focused recommendations for siting, design, and prioritized implementation of green infrastructure measures and drainage improvements that promote community resilience.

Figure 1-1 Flooding at the 5700 Block of Louis XIV Street on September 4, 2023

Figure 1-2 Flooding at the 6700 Block of Marshal Foch Street on April 10, 2024

CNO contracted Jacobs, Digital Engineering Inc (DEI) and CDM to investigate drainage patterns for the Lakeview, West End, and Mid-City areas, respectively. The Lakeview study area is bound by Lake Pontchartrain to the north and I-610 to the south with the eastern boundary at the Orleans Canal and the western boundary at Pontchartrain Boulevard. At West End, the DEI study area begins west of Pontchartrain Boulevard. Infrastructure within the City interacts between neighborhoods.

1.2. Study Purpose

The purpose of these studies is to assist CNO in developing a holistic conceptual design that focuses on implementable, high-quality, equitable, and cost-effective solutions for the Lakeview project area.

The H&H study and conceptual design will yield the following:

- Understanding of problem areas and hotspots in the Lakeview drainage basin
- Recommendations for capacity improvements and blue/green solutions that can be applied at a neighborhood level while considering ongoing drainage improvement programs (the Southeast Louisiana Flood Control Program, Hazard Mitigation Grant Program, Joint Infrastructure Program, etc.), as well as future programs
- Information to prioritize strategic infrastructure investments for mitigating flood risk with a return-on-investment methodology
- Benefits of project, public acceptance, funding sources, etc.
- Consideration of both the resilience of the system and the full life-cycle investments the system has received
- Consideration of community impacts and benefits to Lakeview

1.3. Technical Memorandum Purpose

This technical memorandum (TM) documents the results of Task 2: Existing Conditions Model. CNO provided a PCSWMM model, described in detail in Task 1: Data Collection TM. The model has been previously managed and updated by Ardurra on behalf of the Sewerage and Water Board of New Orleans (SWBNO). This TM documents the updates to and validation of the City's PCSWMM model. Specific activities related to the model setup and testing are listed below:

- Update model surface based on 2021 LiDAR
- Addition of field survey data of large infrastructure (36 inches and greater)
- Review of pump stations
- Preliminary model runs, troubleshooting, and optimizing run times
- Boundary conditions for the project area

Three model scenarios will be addressed throughout the scope of this project, including:

- **Existing Conditions** model was inherited from Ardurra and provided by the City.
- **Baseline Conditions** model (NO_10yr_2D_012), covered by this TM, includes updates based on the large infrastructure survey, implementation of the 2D mesh and pump upgrades. This version of the model was used for model calibration, validation and pumps investigation. All results described in Chapter 3 are referring to this version (012) of the model.

- **Proposed Conditions** model reflects the baseline conditions with the implementation of improvements, including green and blue stormwater infrastructure planned to be developed in Task 3.

LEGEND

- Lakeview H&H Study Boundary
- Drainage Pump Station

N

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Figure 1-3:
Lakeview Project Area
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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2. Existing Condition Model Updates

The currently utilized H&H models for the CNO drainage system has been in various stages of development and softwares since the early 1980s. These models utilize EPA-SWMM, XP-SWMM, the Hydrologic Engineering Center's River Analysis System (HEC-RAS), SWMM5, and most recently PCSWMM. Jacobs received the current PCSWMM model provided by CNO for this study. The model provided was developed for SWBNO by Ardurra. After reviewing the current model, the updates made to the provided existing conditions model can be categorized by the following:

- Surface adjustments (see Section 2.2.1)
- Pipe adjustments (see Section 2.2.2)
- Pump updates (see Section 2.2.3)

2.1. Review of Model and Elements

Jacobs conducted a review to understand the existing model setup, become familiar with the calibration data sets, and identify potential gaps in data or model deficiencies. The following reports were reviewed in Task 1, and a summary of previously developed reports and models are found in the Task 1: Data Collection and Analysis TM (Jacobs, 2024):

- The City of New Orleans Stormwater Management Capital Improvements Plan (CDM Smith 2012)
- Engineering Investigation of Lakeview and Mid-City Basin Drainage Systems (BCG Engineering and Consulting, Inc. 2016)
- Stormwater Master Plan Report (prepared for SWBNO by Ardurra and ILSI Engineering, 2022)

Figure 2-1 shows the existing condition model elements as CNO for the service area included junctions, conduits, storage areas, orifices, and outfalls. The service area was clipped to the Lakeview project area and converted to an updated version of PCSWMM, PCSWMM Professional 2D 7.6.3675.

Figure 2-1 PC SWMM Model Elements

2.2. Model Adjustments

This section contains a review of the current model adjustments: surface adjustments, pipe adjustments, and pump updates. The Surface Adjustments subsection contains analysis of the topographic data, subcatchment and storage curves, and the two-dimensional (2D) validation development. The Manholes and Pipes Adjustments subsection contains discussion of the results of the large infrastructure survey data conducted by Batture Engineering and the related model updates. The Pump Updates subsection covers the updates to the existing conditions pump curves based on operational and nameplate pump data received from SWBNO.

2.2.1. Surface Adjustments

The existing conditions one-dimensional (1D) model, discussed in depth in the Task 1: Data Collection and Analysis TM (Jacobs 2024), was updated for the development of the 2D model. The 1D model was developed with 133 stage-storage curves within the Lakeview project area (Ardurra and ILSI Engineering 2022). Based on data collected throughout Task 1, it was determined the initiation of the stage-storage curves by Ardurra was developed in the 1D model to decrease flooding. Documentation regarding the development of the stage-storage curves was not readily available. The Jacobs modeling team attempted to adjust the stage-storage curves using 2012 USACE HSDRRS LiDAR DEM: New Orleans (OCM Partners, 2024) to remove excess storage represented by the dual drainage network. This update resulted in an inconsistent application of stage-storage curves across the model domain, due to lack of documentation regarding initialization of the stage-storage curves. The initial model update approach included updating the stage-storage curves using 2021 LiDAR resulted in the undoing of previous adjustments to account for dual drainage, and a pivot in methodology was required.

Advancements in 2D modeling with PCSWMM and improved computation capacity led to the decision to convert the model from 1D to 1D/2D. The 1D/2D model represented surface storage with a mesh (2D area) rather than stage-storage curves. The benefits of converting the model to 1D/2D include removing uncertainties associated with stage-storage curves and providing a way to address the large volumes of overland flow observed during the recent flooding events. The 1D/2D models provide an enhanced understanding of overland flow paths (areas where flooding occurs), visualization of spread, and additional animation options. The 1D/2D models are particularly useful when considering a system where storm events far exceed the capacity of storm drainage infrastructure, as is the case with New Orleans.

The model surface adjustments utilized topography data from a recent high-resolution LiDAR Digital Elevation Model (DEM). The 2021 DEM data was collected by the Sanborn Map Company, Inc. in November 2021 (OCM, 2024). The horizontal datum is the State Plane Louisiana South NAD83, and the vertical datum is NAVD88. The 2021 DEM has a 0.5 m spatial resolution. The vertical accuracy of the 2021 DEM is 0.078 m for non-vegetated areas and 0.09 m for vegetated areas (Sanborn Map Company, Inc 2022). The following steps were taken to update the model:

- Creating a polygon representing 2D area within the Lakeview project area (468 subcatchments with a total area of 6.57 km2)
- Removing dual drainage (street conduits) within 2D area
- Converting storage areas into 1D junctions within 2D area
- Adjusting rim elevation for all 1D junctions within 2D area based on 2021 DEM
- Creating a mesh (2D cells) using the 2021 DEM (2D junctions and 2D conduits have 30-foot (ft) depth)
- Connecting subcatchments to the 1D junctions, that were previously represented as storage areas. The only exception are three subcatchments (HUSWB_EB_58_CDM, HSTOR_EB_09_CDM, HSTOR_EB_72_CDM), which were not connected to 1D pipe network in the original model. In the current version of the model those catchments are connected to the closest 2D junction.

The mesh (2D area) was generated for the Lakeview project area using a rectangular shape, 35 ft resolution for roads, and 70 ft resolution for the remaining area (Appendix Figure B -1). Rectangular mesh is often used to represent roadways and corridors. The Lakeview project area is a network of roads and parcels within a grid ,and a rectangular shape is more appropriate. Manning's roughness values for 2D conduits were adjusted to reflect three types of land use: roads (0.015), buildings (0.1), and remaining

area – green space (0.05). See Appendix Figure B -2 for a figure showing the selected roughness values for 2D conduits across the model domain.

Table 2-1 Model Parameters

Parameter	Details	Value
Surface – Roads	2D rectangular mesh	35 ft resolution
Surface – Remaining Model Domain	2D rectangular mesh	70 ft resolution
Land Use – Roads	Manning's roughness	0.015
Land Use – Buildings	Manning's roughness	0.1
Land Use – Green Space	Manning's roughness	0.05
Catch Basin	Six per junction	24 ft width by 0.75 ft height

As in the existing model (Ardurra and ILSI Engineering, 2022), subcatchments remained connected to 1D junctions using a bottom orifice representing a catch basin (Cyclomedia, 2024). To effectively model the surface roadway flow, the average number of catch basins per 1D junction was determined using City GIS. It is worth noting that 1 junction does not represent directly 1 intersection. Having that in mind the catch basins were included in the model with parameters representing six catch basins per 1D junction. The average dimensions of a catch basin (4 ft width, 0.75 ft height) were taken from Proposal and Construction Specifications (Pinnacle Engineering, LLC 2019) to properly represent the storm sewer system. Based on these findings, a width of 24 ft and a height of 0.75 ft were used as the dimensions of the orifice representing the catch basins.

2.2.2. Manholes and Pipes Adjustments

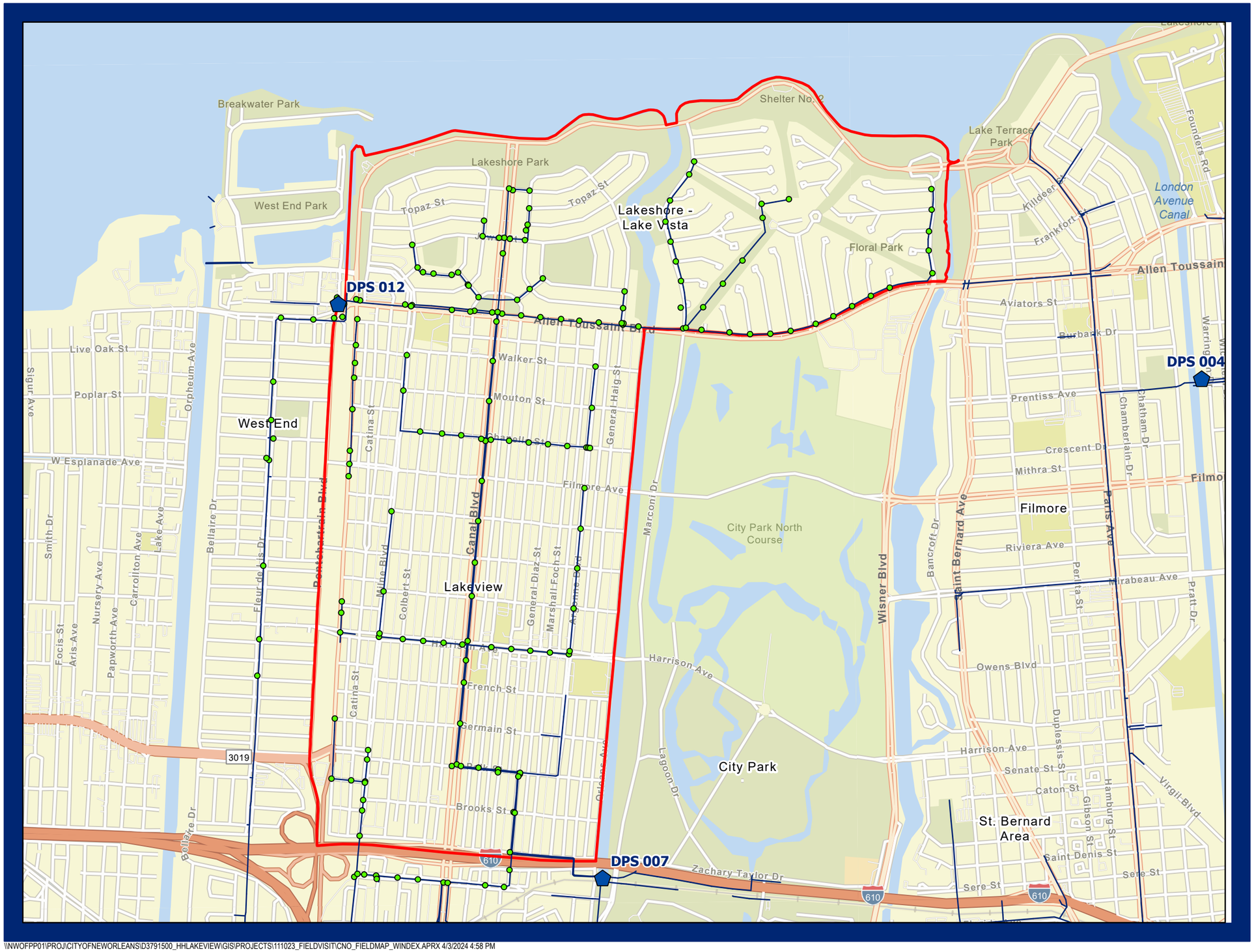
Jacobs' subconsultant, Batture Engineering, conducted a survey of major drainage structures (pipes greater than or equal to 36 inches in diameter) within the Lakeview project area. Figure 2-2 identifies the structures surveyed. Figures and tables containing survey project limits are provided in Appendix C. The survey included locations, tops of casting, invert elevations, and drain structure sizes (shown as a figures in Appendix C.1 and as data summarized in Appendix C.2). Field surveys were conducted for 189 manholes (see Appendix C.3). Overall results included:

- 143 manholes with incoming and outgoing pipe inverts
- 4 manholes without inverts (unable to open)
- 22 manholes located outside the Lakeview project area
- 32 manholes located on the minor drainage system (pipes greater than or equal to 36 inches)

After review of the infrastructure survey data, 36 manholes were not used for the Lakeview project area model update. The excluded manholes were located outside the model domain or were part of the minor system, which is not represented in the 1D/2D model. Figure 2-3 presents a comparison of the invert elevations of the existing and updated manholes. Overall, approximately 78% of manholes had the updated invert elevation from the infrastructure survey lower than it was in the Ardurra model. The average difference between the updated and the Ardurra invert elevation is approximately -0.74 ft (Figure 2-3 and Figure 2-4, Appendix C.3). Based on the Batture survey, the shapes and dimensions of the pipes were updated (Appendix C.4), including:

- 59 pipes updated from rectangular to circular
- 1 pipe updated from ellipsoidal to circular
- 58 pipes updated height and width

Height and width updates ranged from -1 ft to +1 ft; however, a decrease in pipe diameter was noted 67% more often than an increase (Appendix C.4). To ensure all updates were sufficiently identified in the model, data tags were implemented. The data tag used to identify all surveyed updates was "Y" (yes) in the new attribute named "Batture". To assist in the development of any future models, all data tags used are discussed further in Section 2.4.



LEGEND

- Lakeview H&H Study Boundary
- Major Drainage Structures (>= 36")
- Drainage Pump Station
- Infrastructure Survey Data Points

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Figure 2-2:
Batture Infrastructure Survey
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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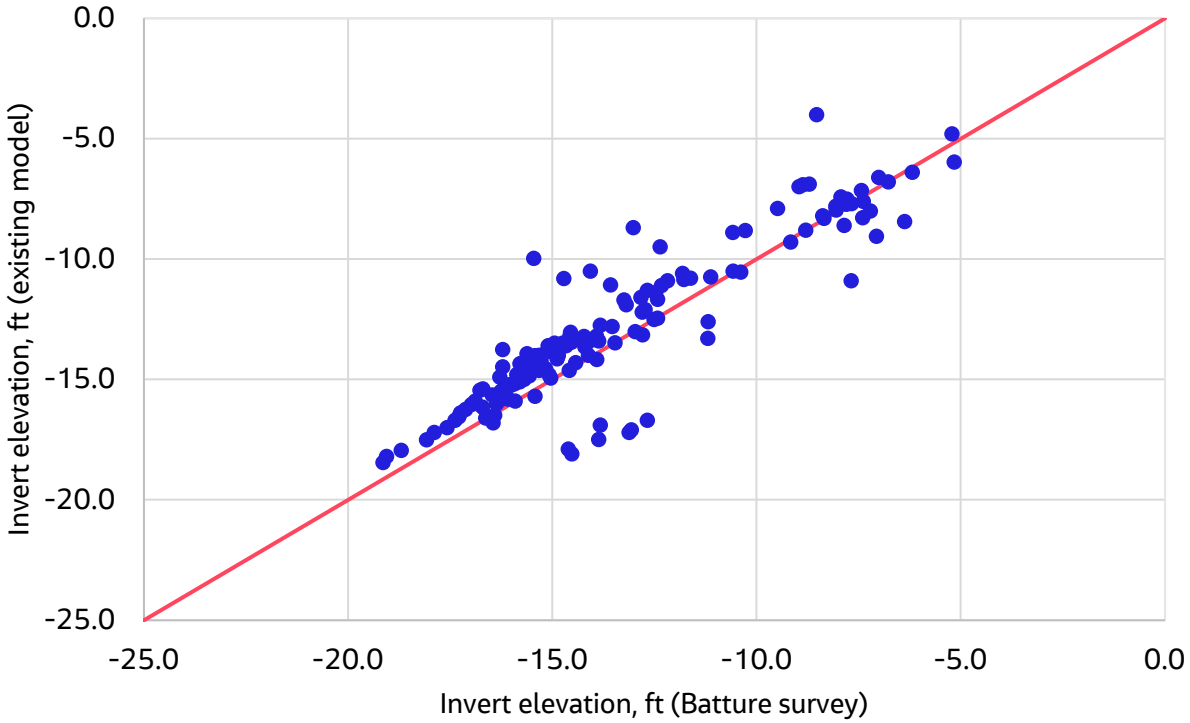
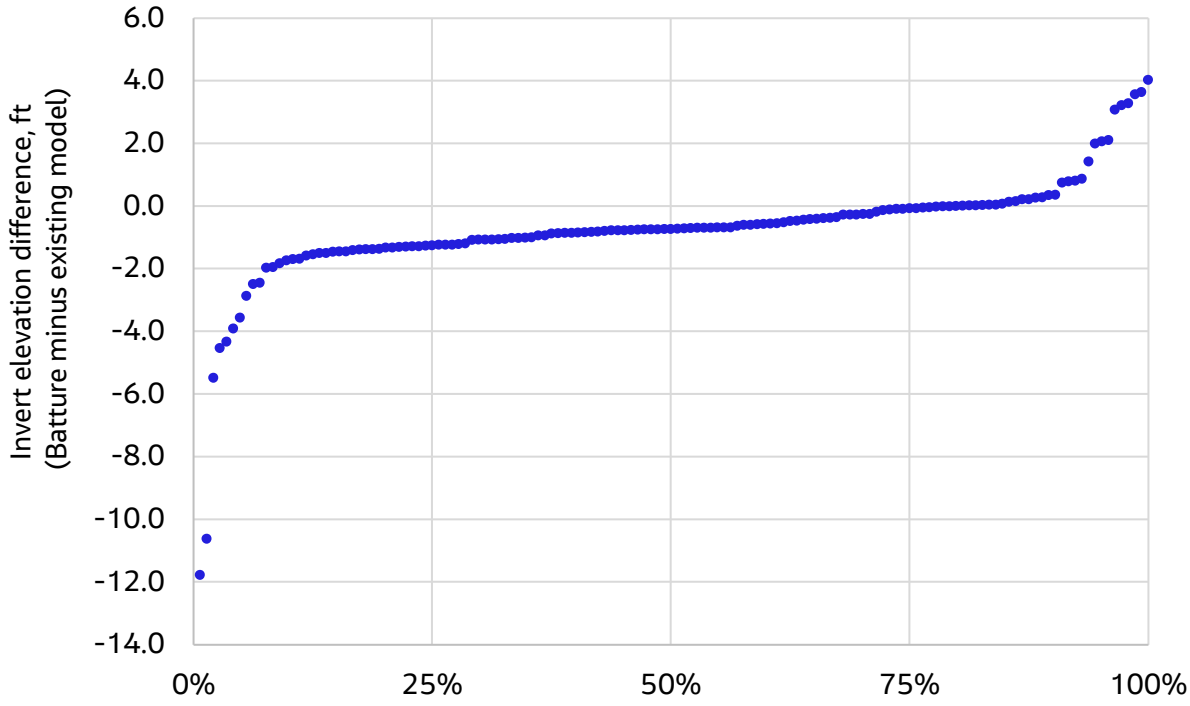
Figure 2-3 Invert Elevation Comparison



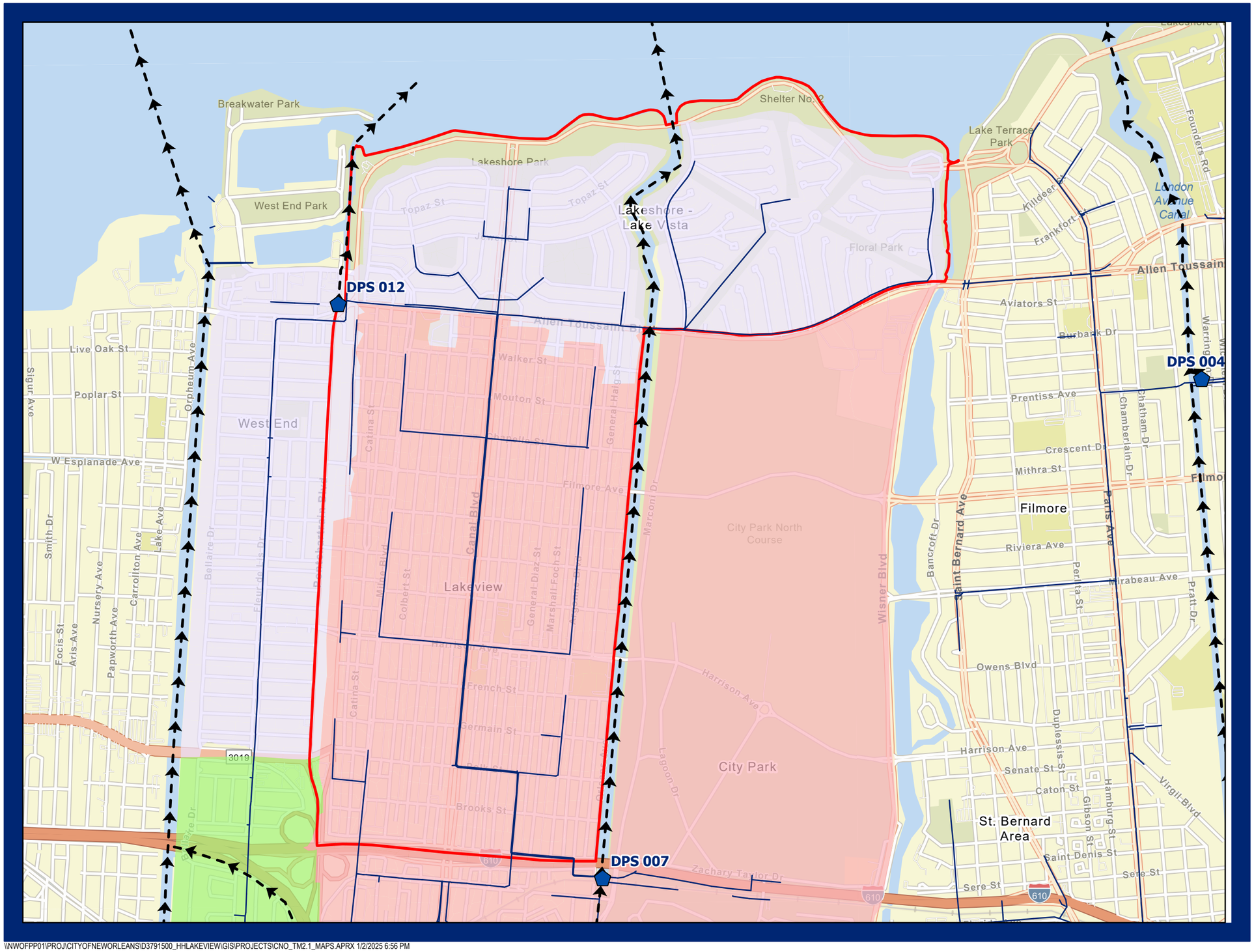
Comparison between the invert elevations of manholes within the existing model and those updated based on the Batture survey.

Figure 2-4 Invert and Existing Elevation Difference Comparison



2.2.3. Pump Updates

The Lakeview project area includes the Drainage Pump Station (DPS) 07 and DPS-12. DPS-07 drainage basin includes a major part of Lakeview and City Park and the northern half of Mid-City. DPS-07 is directly downstream of DPS-02—which includes the southern half of Mid-City Basin, Tremé, and Downtown—and discharges into the Orleans Canal, which in turn discharges into Lake Pontchartrain. DPS-12 includes the northeastern part of Lakeview, City Park, and the West End. DPS-12 discharges directly into Lake Pontchartrain. The DPS system overview for the Lakeview project area is represented in Figure 2-5, taken from SWBNO Stormwater Drainage System Overview Map (SWBNO, 2024) open portal.



LEGEND

- Lakeview H&H Study Boundary
- DPS 2 Basin
- DPS 7 Basin
- DPS 12 Basin
- Major Drainage Structures (>= 36")
- Flow Direction
- Drainage Pump Station

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Figure 2-5:
DPS Basins and Flow Paths
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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The total capacities of the pump stations were collected from nameplate information by Jacobs team in 2017 at each pump station, summarized in Table 2-2. Jacobs received additional gauge data from SWBNO, including suction level, state data, and peak power data for the storm events, discussed further in Section 3.1. The additional data was used to validate the pump station operations. The suction level measures the discharge and intake (ft) in 5-minute intervals, peak daily power is measured in hertz, and the state data includes numerical representations of the pump status in 5-minute intervals. The numerical state values are described by SWBNO as follows:

- 4 – Running Loaded
- 3 – Running Light
- 1 – Ready
- 0 – Not Available
- Bad Input – Loss of communication during event, no data recorded

Table 2-2 Existing Conditions Nameplate Individual Pump Capacity

Station ID	Equipment Name	Type of Pump	Diam (ft)	Nameplate Cubic Feet per Second (CFS)	Power Req'd (megawatts)
7	A	Large	12	550	1.1
7	C	Large	14	1,000	2
7	D	Large	14	1,000	2
7	CD #1	Constant Duty	3	70	0.14
7	CD #2	Constant Duty	3	70	0.14
12	D	Large	14	1,000	2

After initial review of the existing conditions model, as discussed in the Task 1 TM, the total capacity of pump stations modeled was inconsistent with Ardurra's existing conditions model results. The capacity of the existing conditions model was approximately 75% of the nameplate capacity for DPS-07 and 106% of the nameplate capacity for DPS-12, summarized in Table 2-3 The reduced capacity at DP 07 is due to FEMA guidelines. SWBNO and Ardurra have confirmed this assumption. Modifications to the pump station were conducted during validation and are discussed further in Section 3.1.

Table 2-3 Existing Conditions Total DPS Capacity

Station ID	Number of Pumps	Nameplate DPS Total Capacity (CFS)	Existing Conditions 10-year Capacity	Percent
7	5	2,690	2,023	75%
12	1	1,000	1,064	106%

2.3. Rainfall Data

The existing model uses 24-hour design rainfall events based on the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 (NOAA 2018). Rainfall totals were determined based on the precipitation frequency estimates. The depth-duration-frequency (DDF) curves are shown in Figure 2-6. Production runs will include 1-year, 10-year, and 25-year 24-hour storm events.

Figure 2-6 DDF Curves (NOAA 2018)

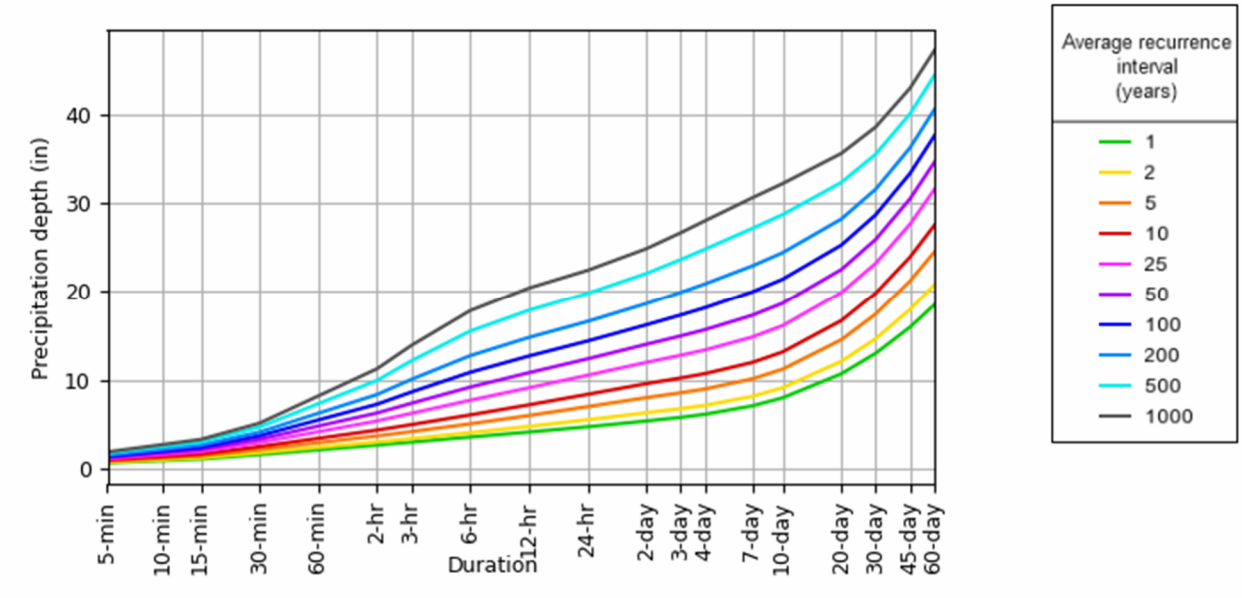


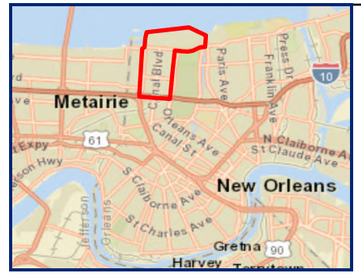
Table 2-4 Production Run Depths

Frequency	Duration	Total Rainfall Depth (in)
1-year	24 hours	4.65
10-year	24 hours	8.32
25-year	24 hours	10.5

2.4 Project Area Coordination and Boundary Conditions

The boundary condition defines the external conditions or inputs that affect the simulation. These conditions set the limits or constraints under which the model operates and can significantly influence the behavior and outcomes of the simulation. The boundary conditions will be determined based on coordination with neighboring project areas at outfalls. The boundary conditions in the updated model will reflect the interaction between the project areas as shown in Figure 2-7.

Collaboration between the Jacobs, DEI, and CDM consultants is crucial in determining the effectiveness of the studies. Jacobs, DEI, and CDM will provide each other with hydrographs for the Mid-City (CDM), West End (DEI), and Lakeview project areas for a 10-year 24-hour storm event with highlighted points for comparison. Neighboring project areas are shown in Figure 2-7.



LEGEND

Project Boundaries

- Lakeview H&H Study Bounds
- Mid City/Narvarre/City Park H&H Study Bounds
- West End H&H Study Bounds
- Drainage Pump Station

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Figure 2-7:
Boundary Coordination
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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2.4. Data Tags for Model Development

To continue coordination and organization of the model development data attributes (Data Source & Quality and Managed Data Source) are used for proposed model conditions and are summarized in Table 2-5. All model data tags are down in Appendix H.

Table 2-5 Data Tags for Model Development and Updates

Type	Attribute Abbreviation	Name	Description
Data Source and Quality	R1	Rank 1	Surveyed data
	R2	Rank 2	Past model data
	R3	Rank 3	Drawings and as-builts from Recovery Roads program data
	R4	Rank 4	Other data source
Managed Data Source	CA	Calculated	Calculated or interpolated (e.g., PCSWMM- or GIS-calculated manhole rims)
	AS	Assumed	Assumed using reasonable engineering judgment/simple calculation
	NA	Not Applied	No changes in model parameters applied

3. Existing Conditions Calibration and Validation Data

3.1. Model Inputs

Following model updates, Jacobs performed model calibration and validation based on the availability of data. Validation is a process of comparing the model and its behavior to the real system and its behavior. Calibration is the iterative process of comparing the model to the real system, revising the model if necessary, and comparing again until a model is accepted (validated). Model calibration was both qualitative and quantitative. Quantitative comparisons included resident observation depth and suction level height data for the September 4, 2023, and April 10, 2024, storm events. Due to the limited availability of domain-wide data, calibration primarily involved qualitative comparisons between results of inundation depth and extent and prior flooding observations. Careful attention was given to the condition of the drainage system (e.g., pumping capacity) at the time of the event to be used for calibration. Where data and/or observations are available, more recent storms will be given preference.

Model validation is the process by which model results or model outputs (e.g., flood depths, durations, etc.) are compared to real-world observations to compare the model's correspondence with reality. The goal of the validation process is to verify the accuracy of the model. This is an important step in the study as it confirms the model is a reliable tool for estimating the expected performance of the flood mitigation alternatives. Following the development of the existing conditions model, previous storm events were used to validate the model.

3.1.1. Rainfall Data

Model validation was conducted using storm events previously identified and validation data collected after recent events. Two events were chosen for validation purposes with data found in Appendix D.1:

- September 4, 2023 (Figure 3-1)
- April 10, 2024 (Figure 3-2)

The rainfall data for the validation events was obtained from SWBNO for the DPS-07 and DPS-12 locations. Provided data has been validated, and errors were noted during the period of greatest intensity during each event. The timesteps associated with the rainfall data provided were inconsistent, ranging from 1 second to 1-hour time steps. Therefore rainfall adjustments were required to develop 15-minute rainfall interval that was further applied to the model. For model validation, a conservative approach was taken by choosing the April 2024 event time series from the DPS-07 due to its higher total sum compared to DPS-12 (Table 3-1). A total of 6.5 inches within 8 hours was recorded, which represents the 5- to 10-year recurrence interval for a 12-hour rainfall duration and is close to the 10-year recurrence interval for a 6-hour duration, based on NOAA Precipitation Frequency Estimates (NOAA, 2018) shown in Appendix D.2.

For the September 2023 event, rainfall data was utilized also from the DPS-07 location for consistency purposes. Within this event, a total of 7.59 inches was recorded within 5.5 hours, which is close to the 25-year recurrence interval for a 6-hour rainfall duration. To ensure the accuracy of the total rainfall values, they were cross-checked with the total sums recorded on other gauges in the closest vicinity, which are available through NOAA.

Rainfall hyetographs for September 4, 2023 and April 10, 2024 events that were used for the modelling purposes are presented in Figure 3-1 and Figure 3-2. The September event had one peak around 1 PM, while the rainfall in April was more intermittent, which was noted both by the gauges at DPS-07 and DPS-12.

Table 3-1 Total Rainfall of the Validation Events

Event	Location	Duration	Total Rainfall	Approximate Recurrence
September 4, 2023	DPS-07	5.5 hours	7.59 inches	~25-yr, 6-hr
September 4, 2023	DPS-12	5 hour	7.39	~25-yr, 6-hr
April 10, 2024	DPS-07	8 hours	6.50 inches	~10-yr, 6-hr ~5 to 10-yr, 12-hr
April 10, 2024	DPS-12	8 hours	6.37 inches	~10-yr, 6-hr ~5 to 10-yr, 12-hr

Figure 3-1. September 4, 2023 Rainfall Hyetograph and Cumulative Depth

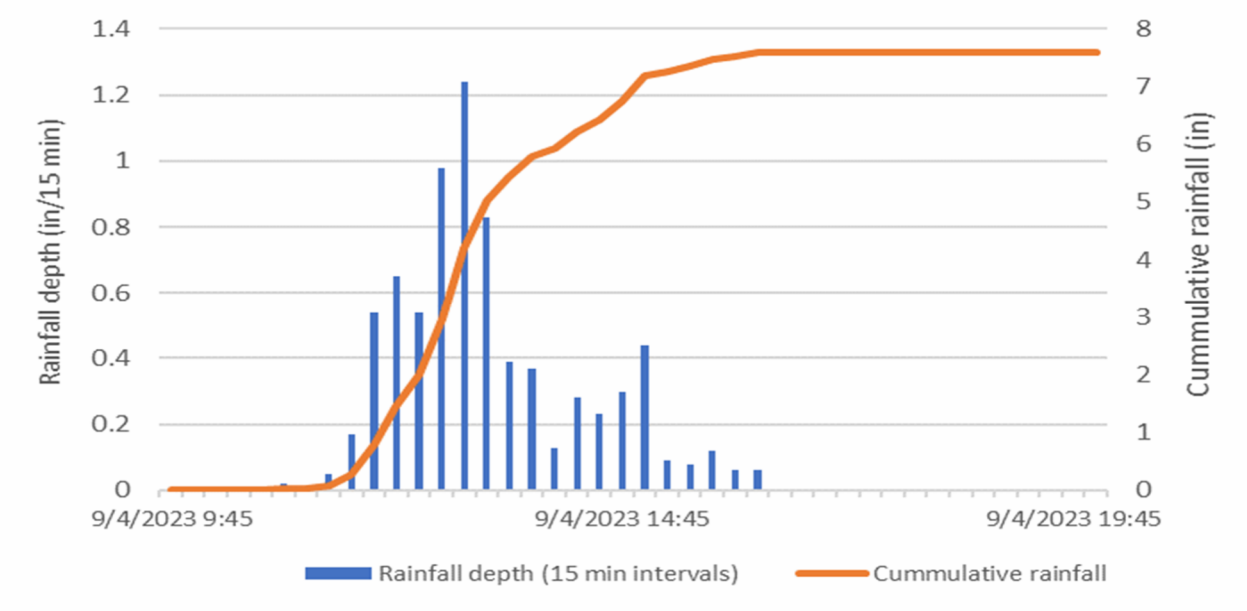
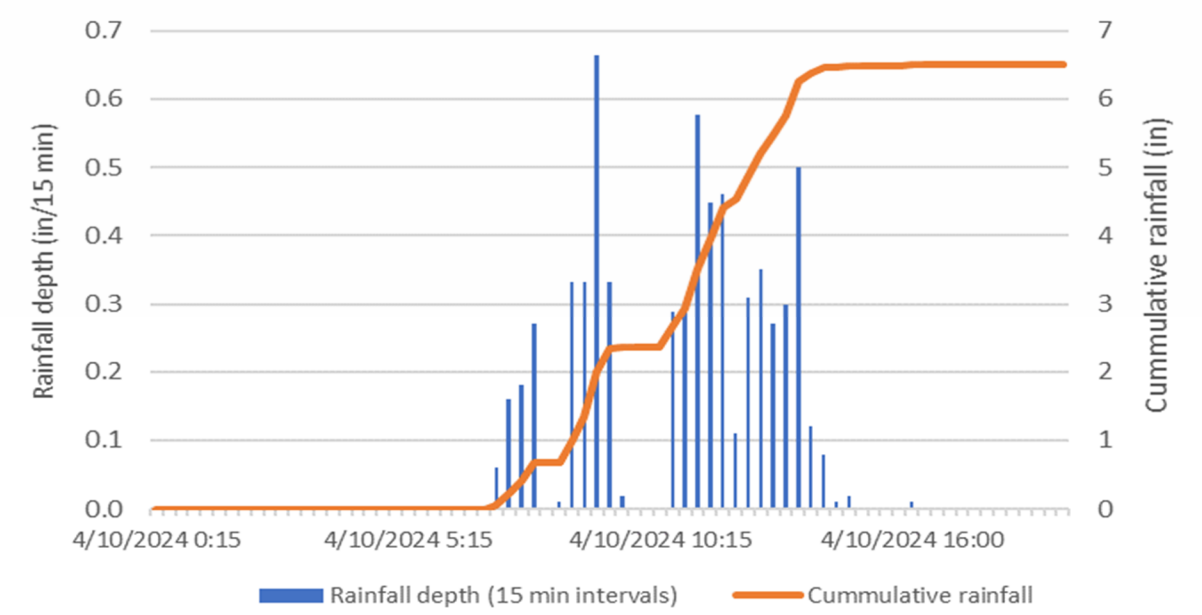


Figure 3-2. April 10, 2024 Rainfall Hyetograph and Cumulative Depth



Climate change will impact the City of New Orleans in a number of ways in the decades ahead, in fact, monthly precipitation totals have already increased in recent years. National Weather Service data assessing "30-year climate normal" indicate that spring and hurricane season monthly precipitation totals have increased (from April through October), when comparing the 1981-2010 period to the 1991-2020 period (NOAA, 2018).

Consideration of climate change impacts in terms of increased storm precipitation intensity, depth, duration and frequency are beyond the current scope of the project, however, it is recommended that these effects be evaluated in future scoped modeling tasks.

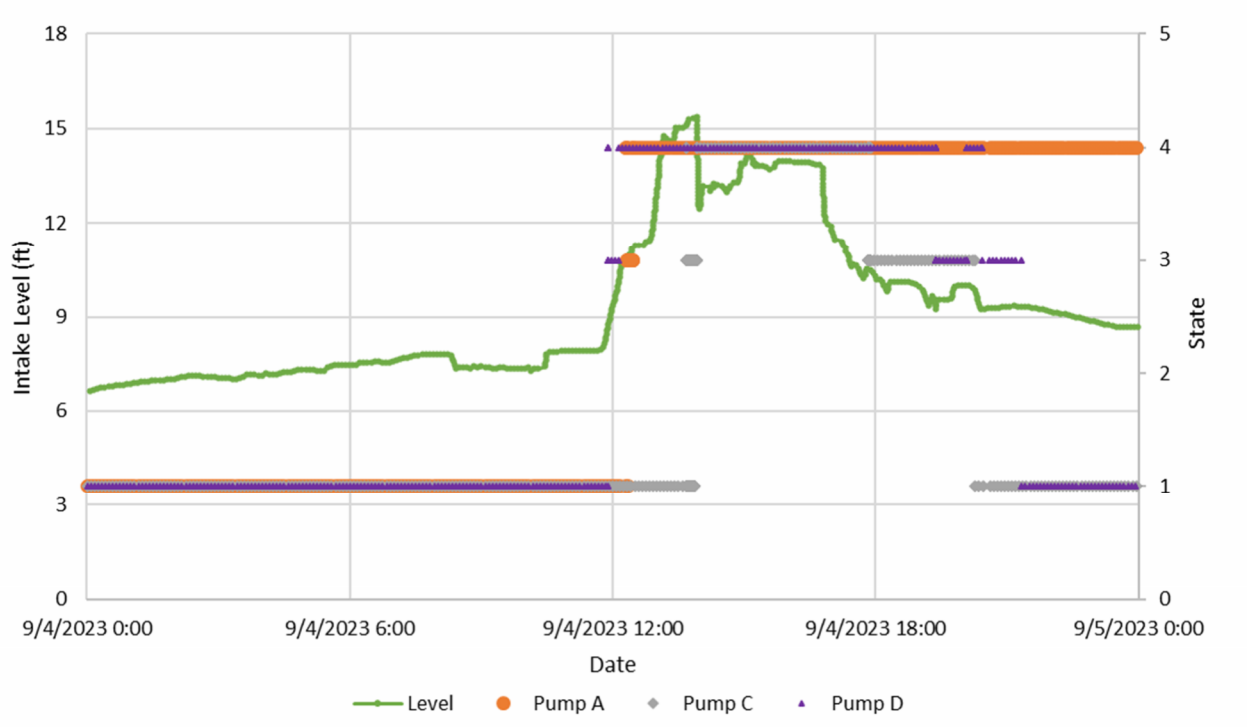
3.1.2. Pump Operation

Pump operation rules were adjusted based on the data provided by SWBNO for September 4, 2023 (Figure 3-3; Figure 3-5) and April 10, 2024 (Figure 3-4; Figure 3-6) events. The data includes an intake level (depth) and a pump state (0 – not available, 1-ready, 3- running light, 4 – running loaded) given with a variable timestep, often less than a minute. Startup depths for selected events were adjusted based on the intake level at the first change of a state (from 1 to 3, or 1 to 4) for Pumps A, C, and D (DPS-07) and Pump D (DPS-12). Shutoff depths were adjusted proportionally to the startup depths as presented in Table 3-2 for DPS-07 and Table 3-3 for DPS-12.

During the September event at DPS-07, Pump D was the first to start when the level reached 8.6 ft (Figure 3-3; Table 3-2). This was followed by start of Pump A (10.7 ft) and Pump C (15.05 ft). DPS-07 operated differently during the April event (Figure 3-4; Table 3-2): Pump A started at intake level of 7.1 ft, and this was followed by Pump D (9.32 ft) and Pump C (11.3 ft).

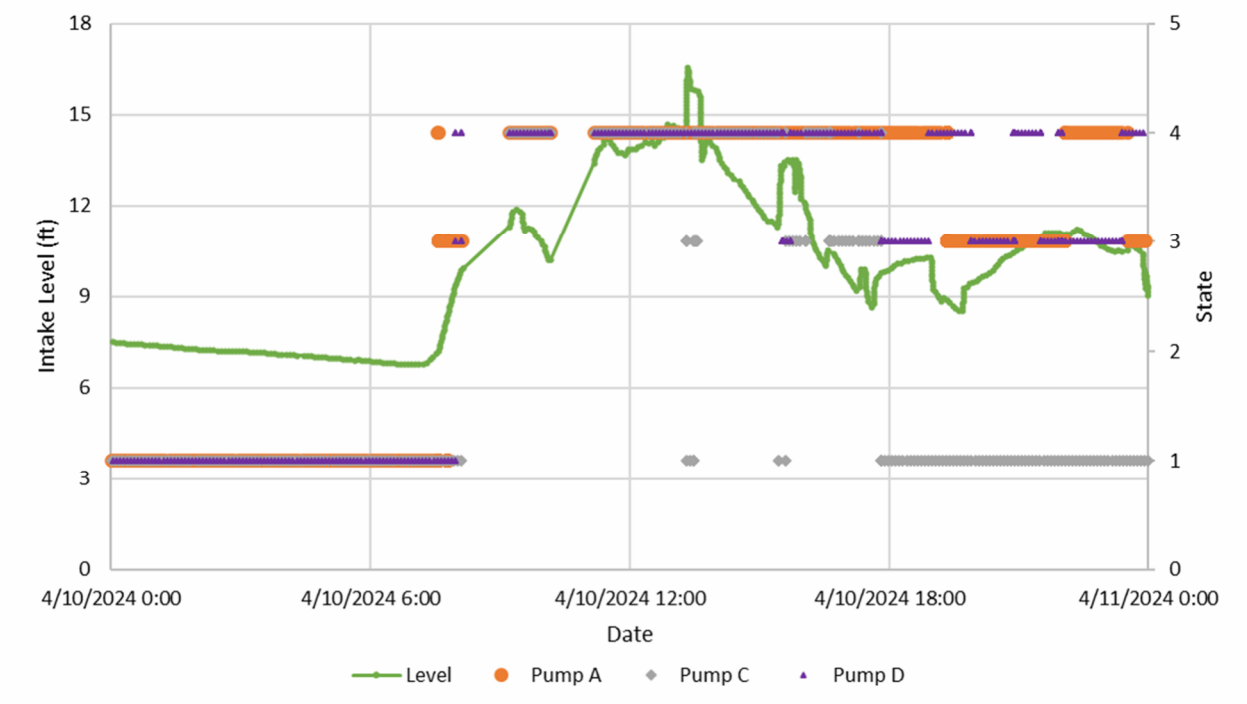
DPS-12 is operating only one pump (Pump D). During the September event it started at 9.2 ft, while in April, it started at 8 ft (Figure 3-5; Figure 3-6; Table 3-3).

Figure 3-3. DPS-07 Pump Intake Level and State on September 4, 2023
Data Source: SWBNO



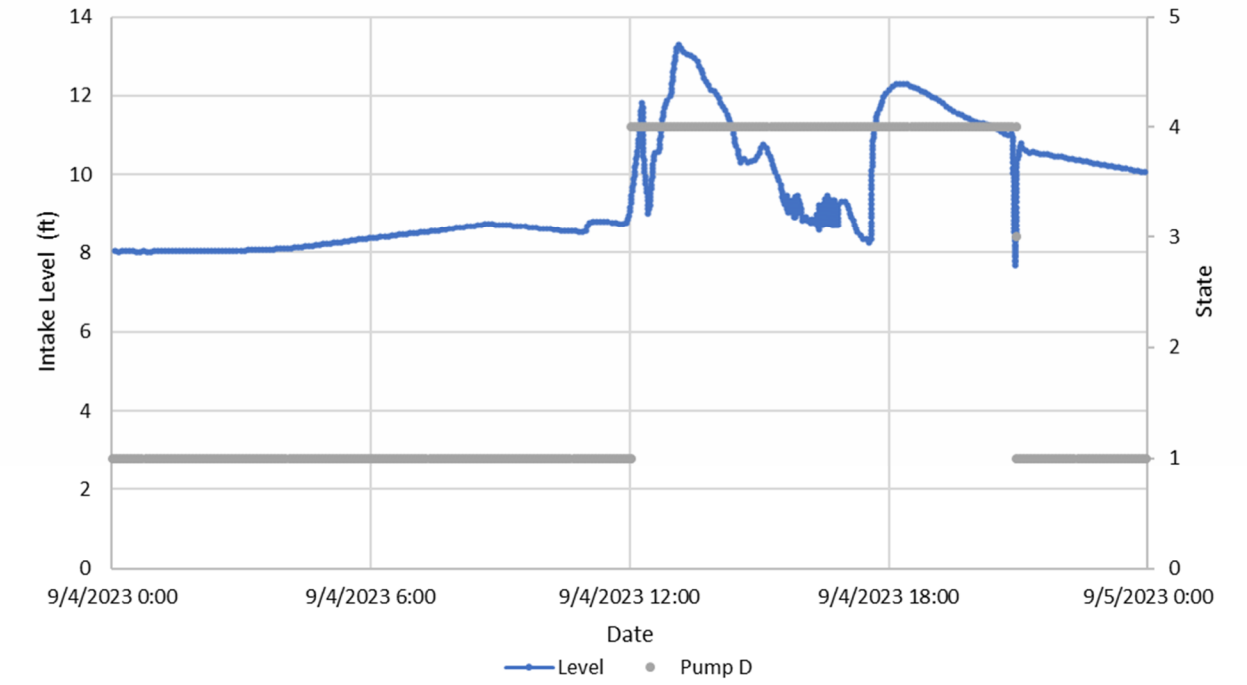
Note: (1 – ready, 3 – running light, 4 – running loaded)

Figure 3-4. DPS-07 Pump Intake Level and State on April 10, 2024
Data Source: SWBNO



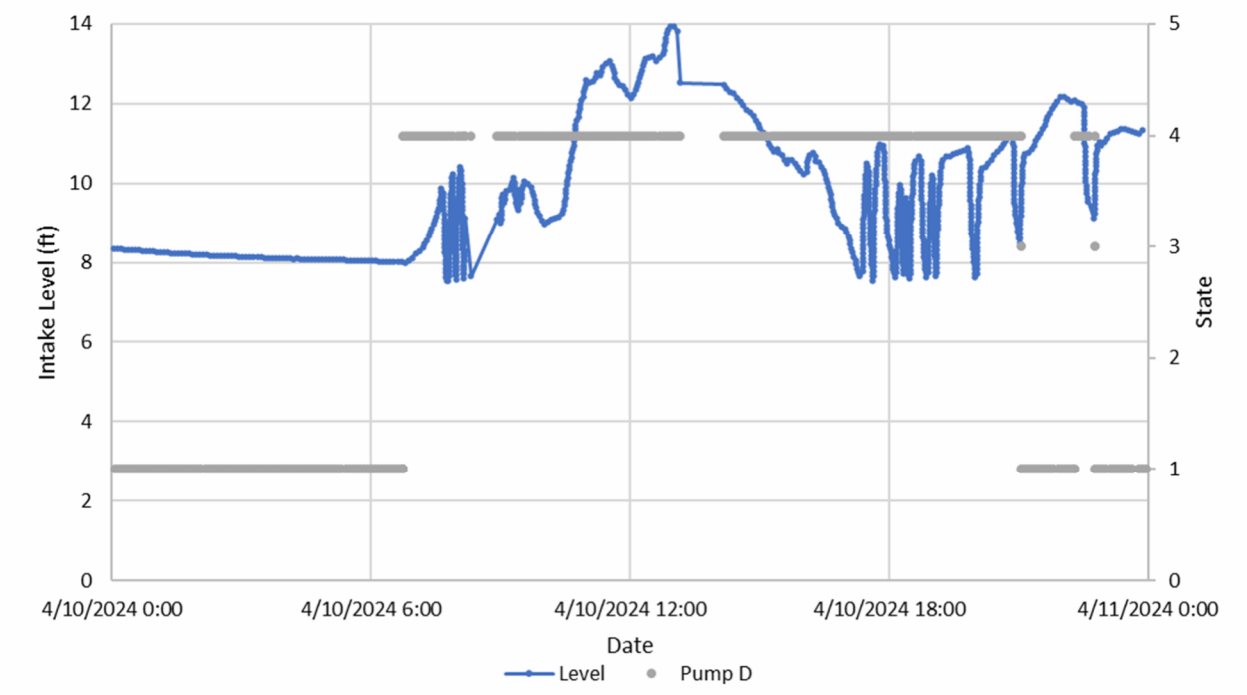
Note: (1 – ready, 3 – running light, 4 – running loaded)

Figure 3-5. DPS-12 Pump Intake Level and State on September 4, 2023
Data Source: SWBNO



Note: (1 – ready, 3 – running light, 4 – running loaded)

Figure 3-6. DPS-12 Pump Intake Level and State on April 10, 2024
Data source: SWBNO



Note: (1 – ready, 3 – running light, 4 – running loaded)

Table 3-2. DPS-07 Validation Event Startup and Shutoff Depths in the Existing Model and Adjusted

Model Pump ID	Inlet Node	Outlet Node	Existing Model (ft)		September 4, 2023 (ft)		April 10, 2024 (ft)	
			Startup	Shutoff	Startup	Shutoff	Startup	Shutoff
P_DPS7-PumpA	DPS07_19367_CDM	PUMP_D1_CDM	8.80	7.80	10.70	9.70	7.10	6.10
P_DPS7-PumpC-1_2	DPS07_19367_CDM	PUMP_D1_CDM	9.40	8.40	15.25	14.25	11.50	10.50
P_DPS7-PumpC-1_4	DPS07_19367_CDM	PUMP_D1_CDM	9.20	8.20	15.05	14.05	11.30	10.30
P_DPS7-PumpC-3_4	DPS07_19367_CDM	PUMP_D1_CDM	9.60	8.60	15.45	14.45	11.70	10.70
P_DPS7-PumpC-Full	DPS07_19367_CDM	PUMP_D1_CDM	9.80	8.80	15.65	14.65	11.90	10.90
P_DPS7-PumpD-1_2	DPS07_19367_CDM	PUMP_D1_CDM	10.40	9.40	8.80	7.80	9.52	8.52
P_DPS7-PumpD-1_4	DPS07_19367_CDM	PUMP_D1_CDM	10.20	9.20	8.60	7.60	9.32	8.32
P_DPS7-PumpD-3_4	DPS07_19367_CDM	PUMP_D1_CDM	10.60	9.60	9.00	8.00	9.72	8.72
P_DPS7-PumpD-Full	DPS07_19367_CDM	PUMP_D1_CDM	10.80	9.80	9.20	8.20	9.92	8.92
P_DPS7-PumpA	DPS07_19367_CDM	PUMP_D1_CDM	8.80	7.80	10.70	9.70	7.10	6.10
P_DPS7-PumpC-1_2	DPS07_19367_CDM	PUMP_D1_CDM	9.40	8.40	15.25	14.25	11.50	10.50
P_DPS7-PumpC-1_4	DPS07_19367_CDM	PUMP_D1_CDM	9.20	8.20	15.05	14.05	11.30	10.30
P_DPS7-PumpC-3_4	DPS07_19367_CDM	PUMP_D1_CDM	9.60	8.60	15.45	14.45	11.70	10.70
P_DPS7-PumpC-Full	DPS07_19367_CDM	PUMP_D1_CDM	9.80	8.80	15.65	14.65	11.90	10.90

Table 3-3. DPS-12 Validation Event Startup and Shutoff Depths in the Existing Model and Adjusted

Model Pump ID	Inlet Node	Outlet Node	Existing Model (ft)		September 4, 2023 (ft)		April 10, 2024 (ft)	
			Startup	Shutoff	Startup	Shutoff	Startup	Shutoff
P_DPS12-Pump1-1_2	DPS12_31839_CDM	PUMP_12D_CDM	6.67	5.27	9.50	8.10	8.30	6.90
P_DPS12-Pump1-1_4	DPS12_31839_CDM	PUMP_12D_CDM	6.37	4.97	9.20	7.80	8.00	6.60
P_DPS12-Pump1-3_4	DPS12_31839_CDM	PUMP_12D_CDM	6.97	5.57	9.80	8.40	8.60	7.20
P_DPS12-Pump1-full	DPS12_31839_CDM	PUMP_12D_CDM	7.27	5.87	10.10	8.70	8.90	7.50

3.2. Observed Conditions

To conduct validation for September 4, 2023 and April 10, 2024, observed conditions information was collected including hot spots from 311 call and councilperson calls/emails, as well as utilizing a partnership with ISeeChange to collect observed watermarks (OWM). The observed watermark indicates the water surface elevation at a specific time during the flood, which may not match the peak, that is normally represented by the high-water mark (HWM).

New Orleans residents are encouraged to voice concerns about drainage to 311, or report issues by visiting NOLA311 online. If by phone, a 311 customer service agent records the physical address nearest to the problem and documents a ticket. Residents may also contact their local councilmember and report drainage issues. Lakeview neighborhood tickets and councilmember emails/calls were documented by CNO and provided to the Jacobs team. Areas of documented flooding issues are considered hot spots (Figure 3-7) and flooding extent. Hot spots were found in similar regions of model maximum depth results.

In coordination with the Water Collaborative, CNO has contracted with ISeeChange, a company that specializes in collaborating with local communities to collect real-time observations of climate events like flooding and heat waves, to collect data within the Lakeview area that can be used for validation purposes. ISeeChange coordinated receipt and compilation of local submissions of flooding events that include dates, photos, and water level measurements. The majority of the submissions received were from the September 4, 2023, and April 10, 2024, storm events. On September 4, 2023, heavy rainstorms led to localized street flooding. SWBNO reported 7.59 inches near DPS-07. Residents at the following addresses shared photos of their experiences:

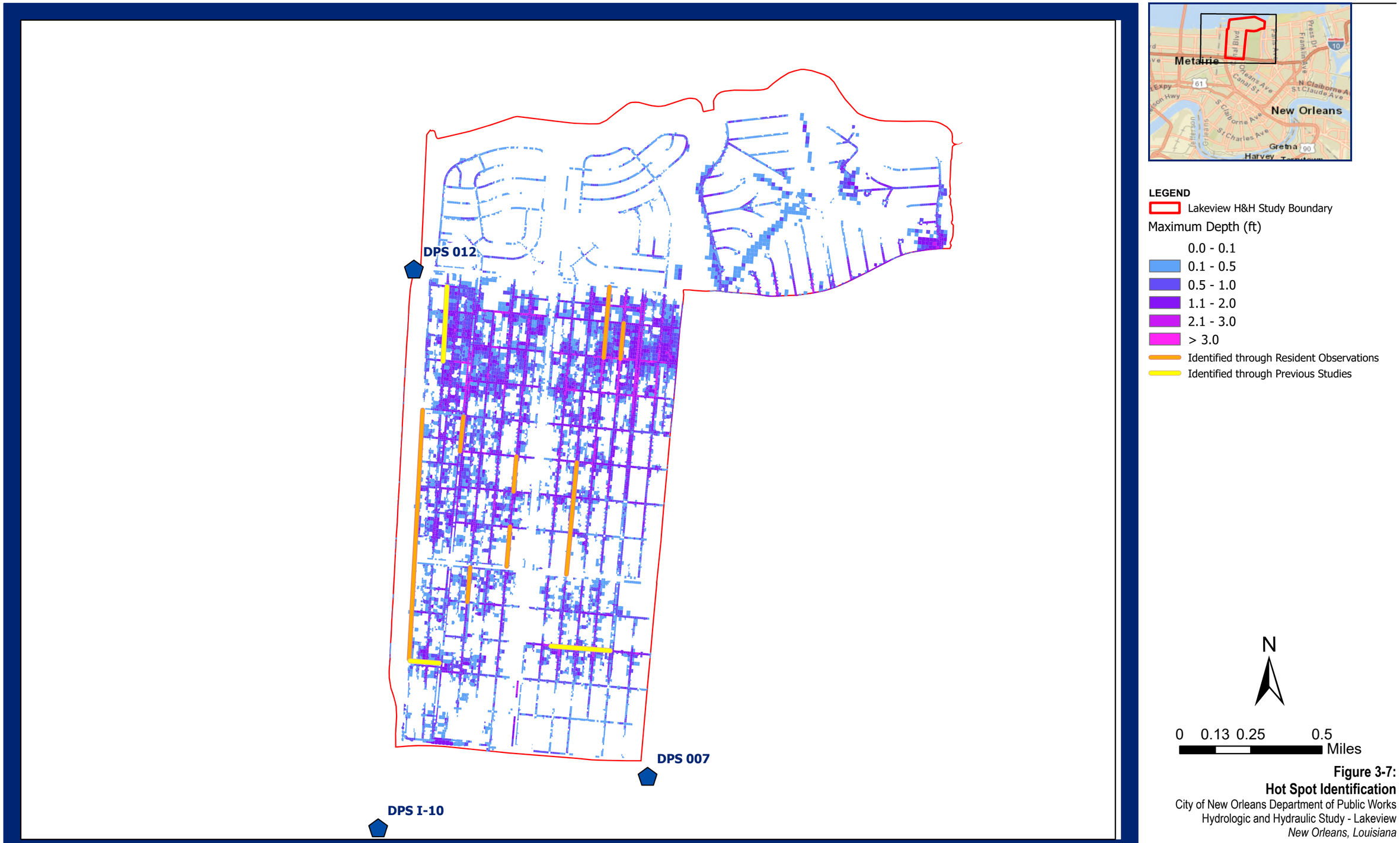
1. 5716 Louis XIV St
2. 6211 West End Blvd
3. 6649 West End Blvd
4. 535 Kenilworth St
5. 6135 West End Blvd
6. 6628 General Diaz St

On April 10, 2024, a strong upper-level disturbance, surface low, and cold front produced a line of severe thunderstorms that pushed across Southeast Louisiana and Southern Mississippi in the morning and early afternoon. The line of severe thunderstorms produced extensive flash flooding in the New Orleans metro area. Residents of the Lakeview neighborhood shared their experience on the platform ISeeChange.com. Pictures shared were reported from the following addresses:

1. 6628 General Diaz St
2. 6208 Milne Blvd
3. 6770 Marshall Foch St

OWM measurements were not obtained through the ISeeChange.com platform. Photos were examined and flooding locations within the right-of-way were flagged to determine elevations of OWMs at the addresses above during the September 4, 2023, and April 10, 2024, storm events.

The Jacobs team and Batture collected OWM elevations on May 15, 2024. Survey locations with photos can be found in Appendix E. Multiple survey points were taken for each location. Roadway construction on 5716 Louis XIV St did not allow more than one observed high-water mark point to be taken.



LEGEND

- Lakeview H&H Study Boundary

Maximum Depth (ft)

- 0.0 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- > 3.0
- Identified through Resident Observations
- Identified through Previous Studies

N

0 0.13 0.25 0.5 Miles

Figure 3-7:
Hot Spot Identification
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_TM2.1_MAPS\TM2.1_FIG.3-1.A.APRX 7/5/2024 1:45 PM

3.3. Pumps Investigation

During the modeling effort, an attempt was made to adjust the model parameters to reflect the observed operations of DPS-07 and DPS-12 pumps during the September 2023 and April 2024 events. Yet, the analysis of observational data obtained from the SWBNO, showed that during the events, the pumps did not have the same start-up and shut off depths. This confirmed DPS operation is controlled manually, depending on the current hydrological situation. A detailed description of schematization and pumps set up used in all runs is presented in Appendix F. Sensitivity runs performed include:

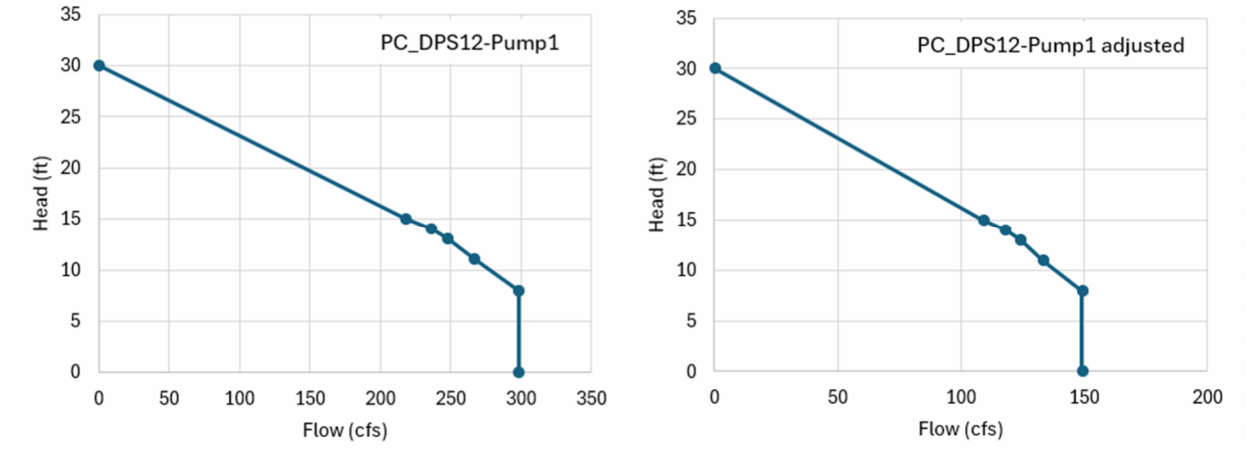
Table 3-4. Sensitivity Runs

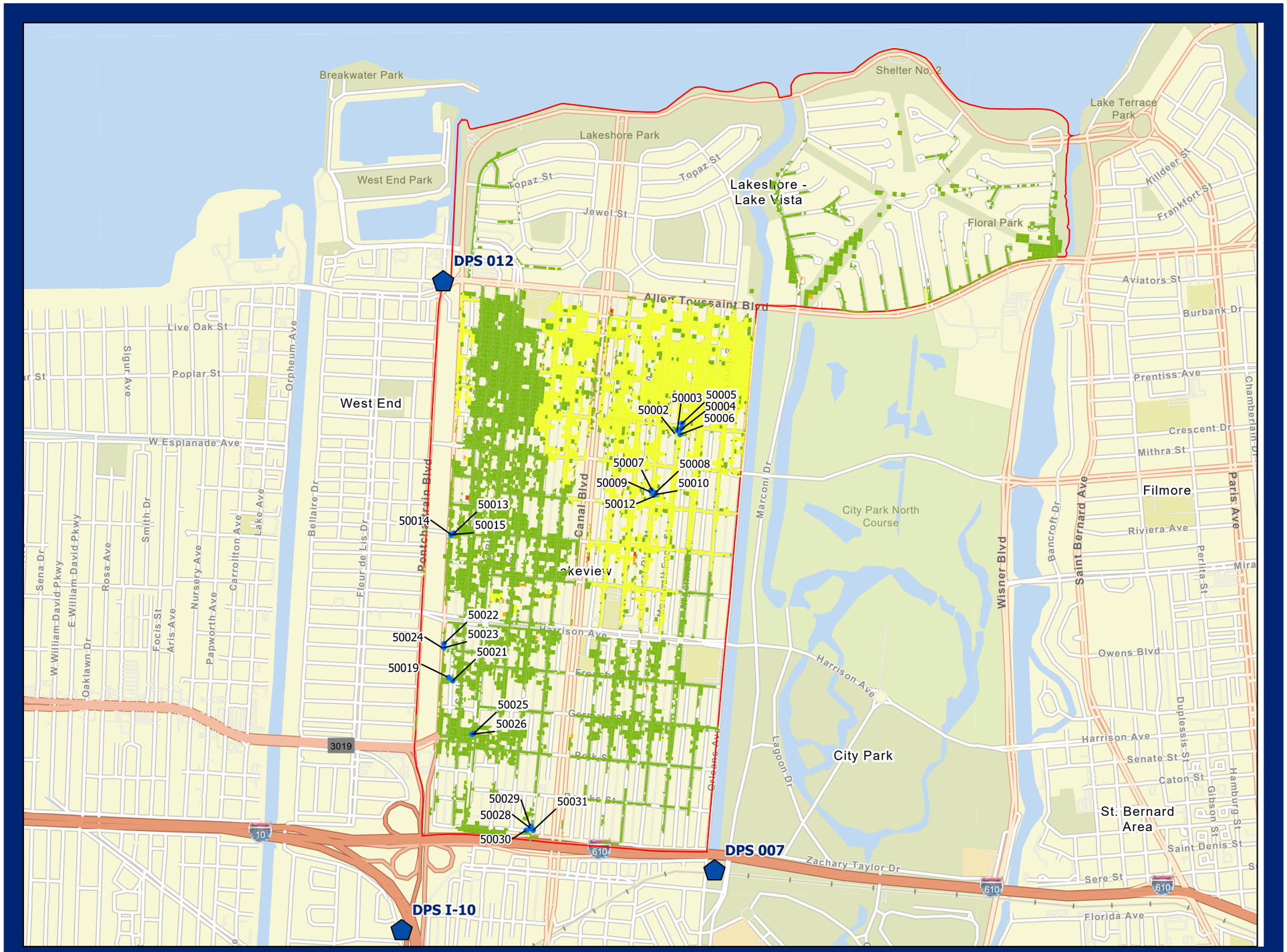
Description	Rainfall	Model Run ID
Decrease of the DPS-12 pump capacity to 50%	April 10, 2024	NO_10Apr24_2D_009_pumps_SA01
Decrease of the DPS-12 pump capacity to 50%	September 23, 2024	NO_Sep23_2D_009_pumps_SA01
DPS-12 and DPS-07 pumps capacity adjusted to 100%	April 10, 2024	NO_10Apr24_2D_010
DPS-12 and DPS-07 pumps capacity adjusted to 100%	September 23, 2024	NO_Sep23_2D_012
DPS-12 and DPS-07 pumps capacity increase to 100%, transects downstream from DPS-07 cropped	April 10, 2024	NO_10Apr24_2D_012
Application of startup and shut off depths for DPS-07 and DPS-12 pumps, observed during the analyzed events, as described in Section 3.1.2.	April 10, 2024	NO_10Apr24_2D_009_pumps
Application of startup and shut off depths for DPS-07 and DPS-12 pumps, observed during the analyzed events, as described in Section 3.1.2.	September 23, 2024	NO_Sep23_2D_009_pumps_SA02

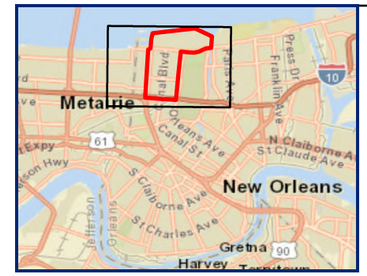
To determine the impact of the DPS-12 pump set up on the Lakeview area, the April 2024 event sensitivity run was conducted (*Model ID: NO_10Apr24_2D_009_pumps_SA01*) in which the pump efficiency was reduced by half. A comparison of pump curves (head versus flow) between existing pump and adjusted is shown in Figure 3-8. An increase in the water surface elevation was noted in the north and northeastern part of the Lakeview by up to approximately 0.3 ft, as shown in Figure 3-9. This change was also noticed as an increased difference between the modeled WSE and surveyed OWM along Marshal Foch Street.

Further analyses of the drainage network revealed a backwater effect that forms in the double barrel beneath the Canal Boulevard. The backwater starts in conduit DPS07_19348_CDM, located just upstream DPS-07. The model results show that if water from the Lakeview area is not discharged by DPS-07 due to its limited capacity, a backflow is created. Backflow extends to the intersection of the Canal Boulevard and Allen Toussaint Boulevard, causing water level to rise in the northern part of Lakeview area.

Figure 3-8 DPS-12 Pump Curve Comparison – Existing versus Adjusted







LEGEND

- High Water Locations
- Lakeview H&H Study Boundary

WSE Difference (ft)

- 0.004 - 0.150
- 0.151 - 0.250
- 0.251 - 0.500
- 0.501 - 1.000

N

0 0.13 0.25 0.5 Miles

Figure 3-9:
Max WSE Difference Map
Existing vs Reduced DPS 12 Capacity
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_TM2.1_MAPS\TM2.1_FIG.3-2.APRX 6/11/2024 4:39 PM

In the Ardurra model DPS-07 pump capacity was decreased to approximately 75% and DPS-12 has been increased by approximately 6%. Sensitivity Runs were conducted to reach 100% capacity of both pumps. The first run (NO_10Apr14_2D_010) involved a decrease of the flow on the pump curve of DPS-12 and an increase on DPS-07. As the change was not sufficient to match the pump total discharge, the flow on the DPS-07 curve has been increased by another 15% (run NO_10Apr14_2D_012), which resulted in a good match for both pumps comparing to the pumps nameplate maximum flow (Table 3-5).

Table 3-5. Nameplate and Sensitivity Run Maximum DPS Flows

Model ID	DPS-07 Pump A	DPS-07 Pump C	DPS-07 Pump D	DPS-07 Sum	DPS-12 Pump 1
Total Nameplate CFS	500	1000	1000	2500	1000
No_10Apr14_2D_009	437	807	807	2050	1070
No_10Apr14_2D_010	417	974	886	2277	1005
NO_10Apr24_2D_012	450	975	975	2401	1004
NO_Sep23_2D_012	472	1007	1007	2486	1039
NO_10yr_2D_012	474	1009	1009	2492	1014
NO_10Apr24_2D_009_pumps_SA01	415	779	779	1973	579

Figure 3-10 to Figure 3-13 present the head values in the junctions located upstream from the DPS-07 (DPS07_19367_CDM) and DPS-12 (DPS12_31839_CDM) pumps compared to the observed intake levels provided by SWBNO for the April 2024 and September 2023 events.

Figure 3-10 DPS-07 Observed Intake Level versus Modeled Head Comparison – April 2024 event
Data Source: Observed intake level provided from SWBNO SCADA

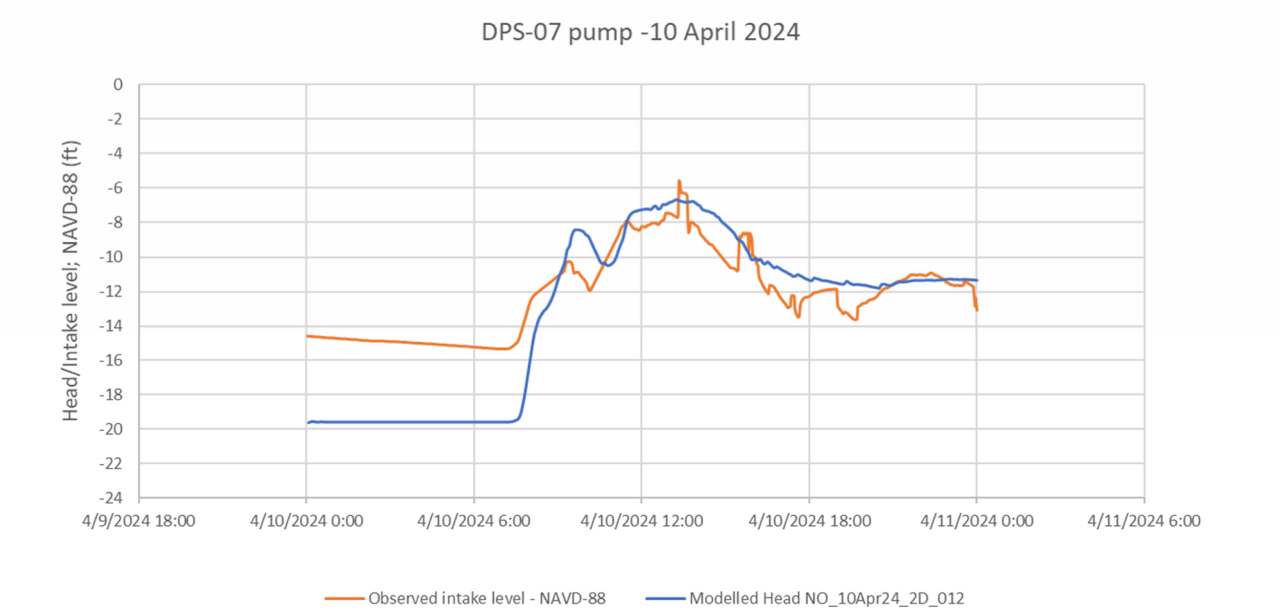


Figure 3-11 DPS-12 Observed Intake Level versus Modeled Head Comparison – April 2024 event
Data Source: Observed intake level provided from SWBNO SCADA

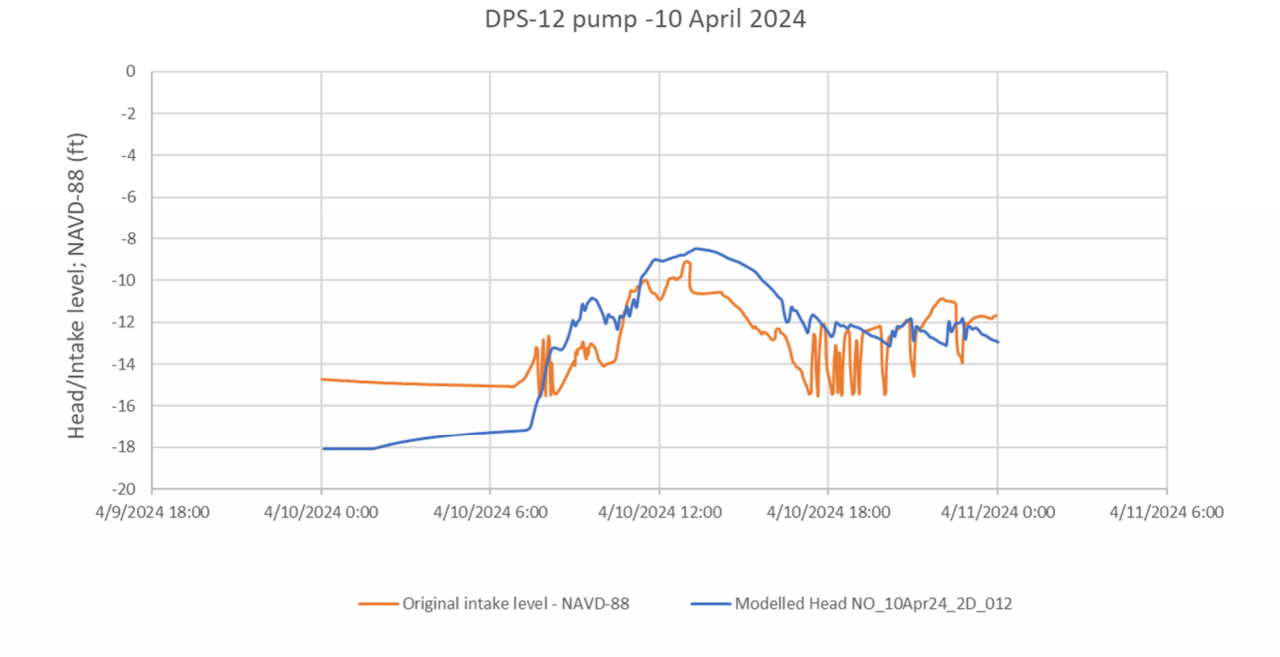


Figure 3-12 DPS-07 Observed Intake Level versus Modeled Head Comparison – September 2023 event
Data Source: Observed intake level provided from SWBNO SCADA

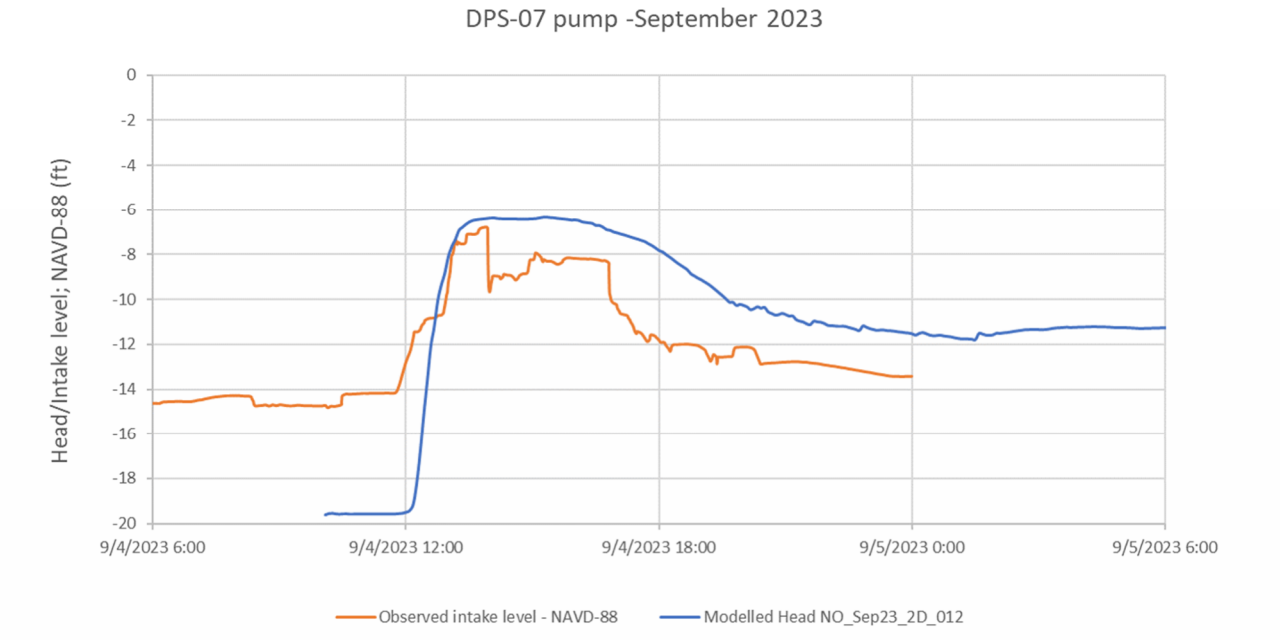
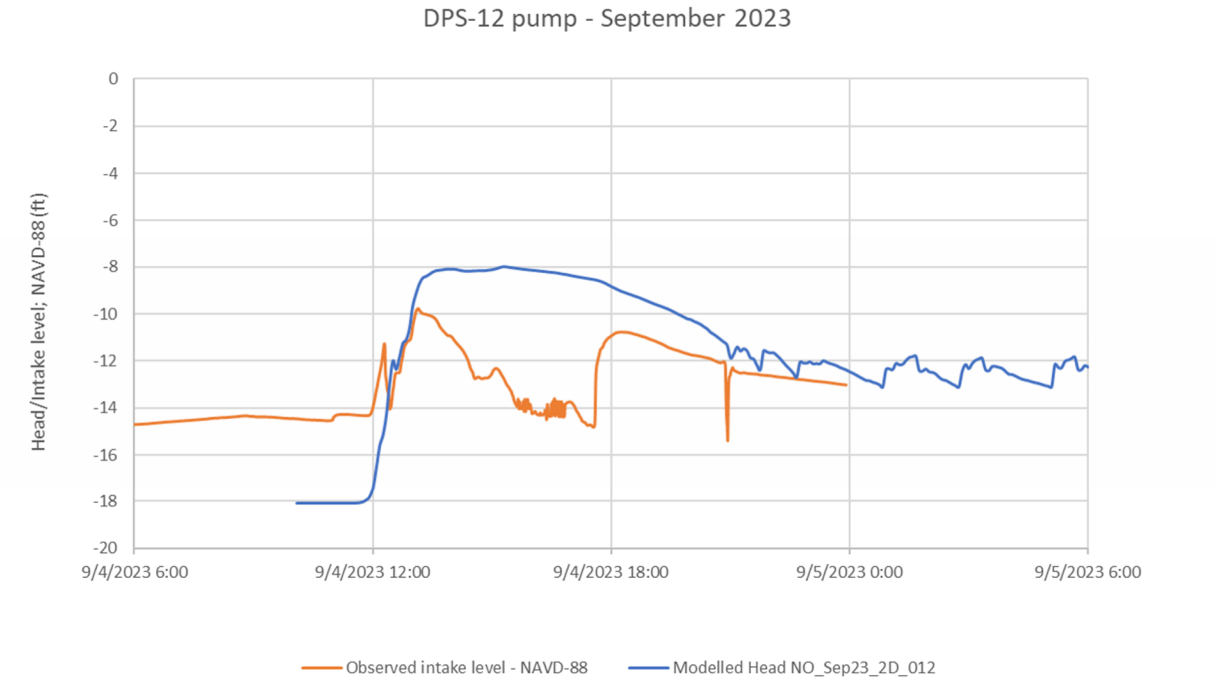


Figure 3-13 DPS-12 Observed Intake Level versus Modeled Head Comparison – September 2023 event
Data Source: Observed intake level provided from SWBNO SCADA



An attempt to match the head timeseries on each of the pumps in the model with the observed values resulted in increased differences in flood depths obtained from the model and the surveyed OWM for the September 2023 event (Figure 3-14) and the April 2024 (Figure 3-15). The best fit was obtained by increasing the efficiency of the DPS-07 pumps to its maximum capacity. Therefore, the NO_10Apr24_2D_012 and NO_Sep23_2D_012 runs are recommended for a validation across the OWM process, and the same pumps set up has been further used for the 10-yr event baseline model set up.

Figure 3-14 Maximum Water Surface Elevation (WSE) and surveyed OWM Comparison – September 2023 event

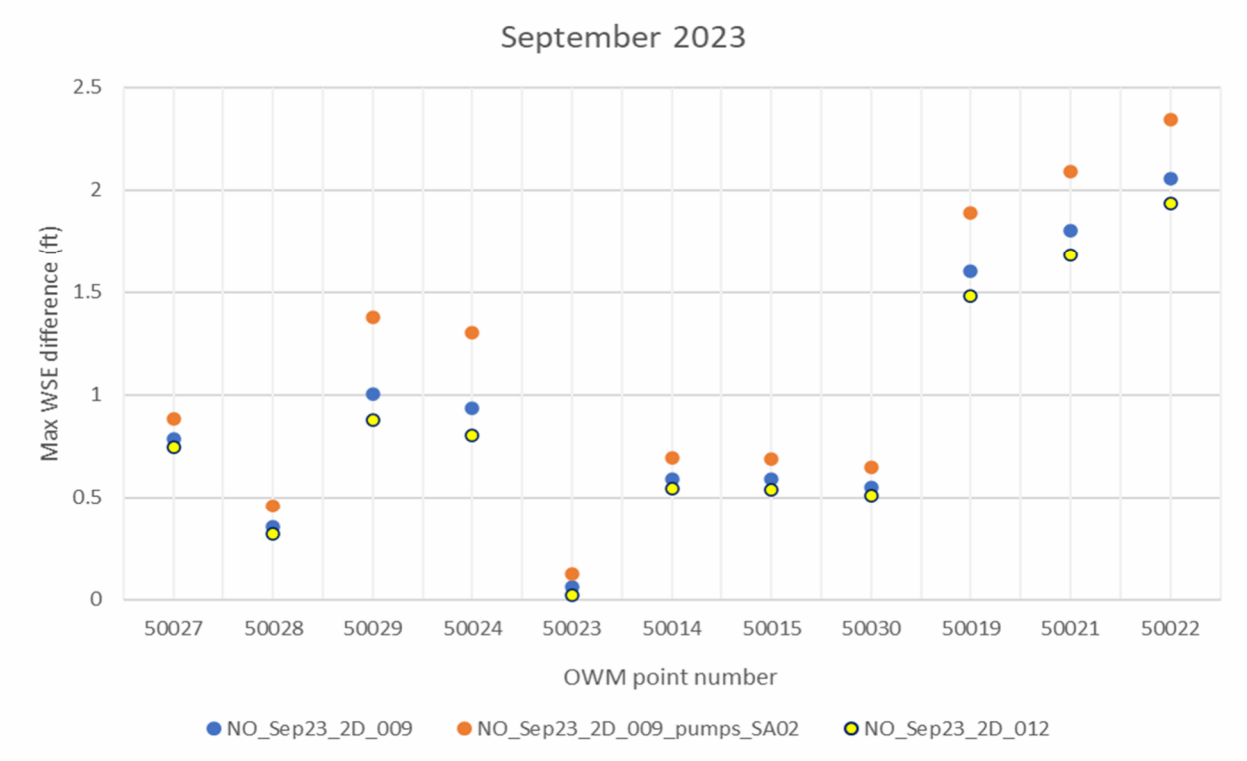
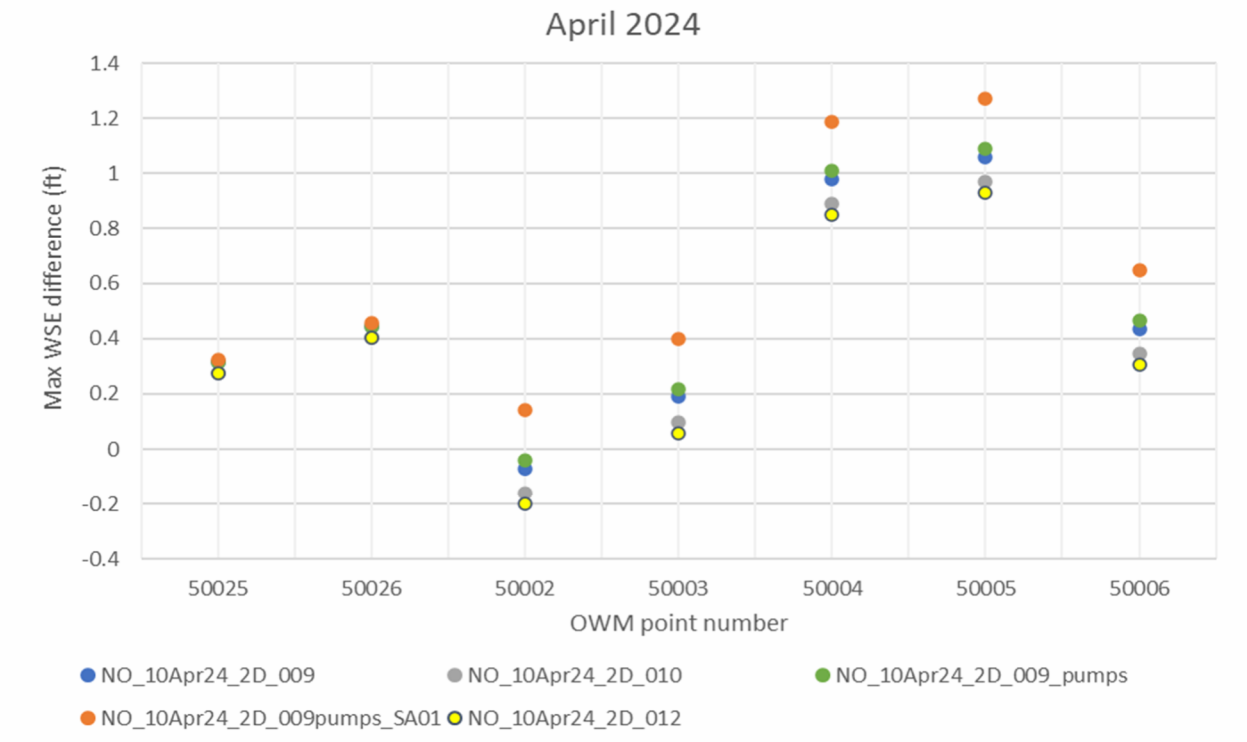


Figure 3-15 Maximum WSE and surveyed OWM Comparison – April 2024 event



3.4. Validation Events

The results from the model have been validated using data described in Sections 3.1 and 3.2. Two recent rainfall events (September 4, 2023 and April 10, 2024) have been applied to the model with the pump set up described in Section 3.3. Obtained maximum WSE have been compared to the surveyed OWM elevation using two approaches:

- **Direct comparison:** where a OWM lies inside a 2D cell, maximum WSE of the 2D cell was directly compared to the surveyed elevation of the OWM (Table 3-6 for September 4, 2023 and Table 3-7 for April 10, 2024).
- **Graphic Visualization:** the OWM elevation was graphically visualized over a WSE hydrograph from a corresponding cell in the model. This helps to understand not only the absolute deviation of the modelled results from values measured, but also to locate the OWM elevation within the hydrograph of the event. It is worth noting that for most of the photos, which were the base for OWM determination, the time of photo is unknown, so it is uncertain if they represent the peak of flood.

Additionally, Section 3.4.3. presents the comparison of the 10-yr baseline results to the areas of documented flooding issues (hot spots) described in Section 3.2.1.

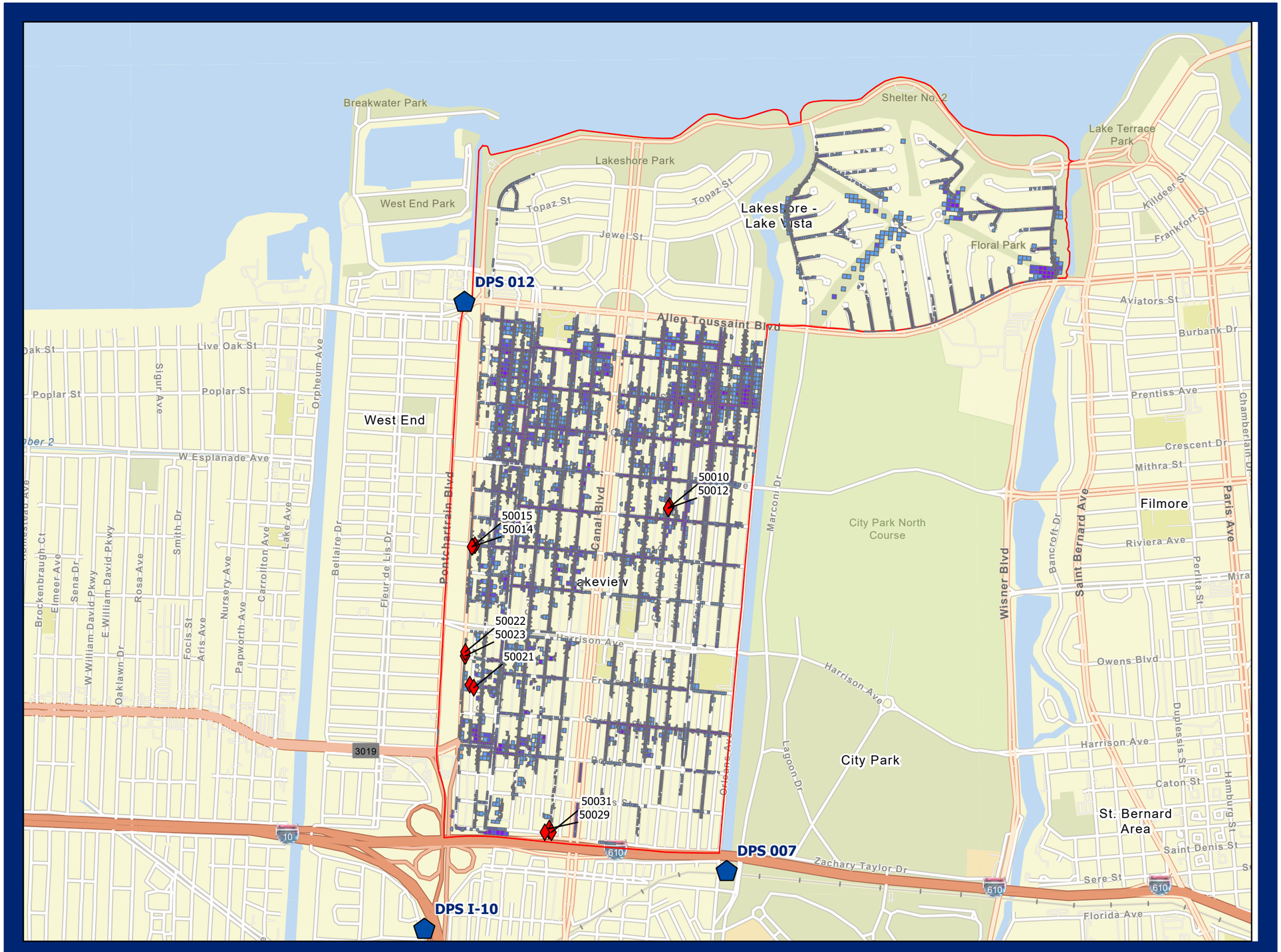
3.4.1. April 10, 2024 Validation Efforts

The flood extent from the April 2024 event simulation aligned with OWM. All OWM points, except two, were located within the flood extent. Nevertheless, 50007 and 50009 points surveyed on General Diaz Street, were located at the edge of the modelled flood outline, as shown in Figure 3-16.

Direct comparison of the modelled maximum WSE at the location of OWM points shows that the results are conservative, and the model is generally greater the flood depths. Calculated differences were in a range of -0.20 - 0.93 ft, with the average of 0.37 ft with most locations having a difference lower than 0.5 ft, as detailed in Table 3-6.

Table 3-6. Validation Results for 10 April 2024 event

Event	ID	OWM (ft)	Max WSE (ft)	Difference (ft)	Description
4/10/24	50009	-7.078	-	Out of flood extent	Mailbox
4/10/24	50007	-6.559	-	Out of flood extent	Neutral ground
4/10/24	50025	-6.213	-5.94	0.273	Front lawn
4/10/24	50026	-6.345	-5.94	0.405	Neutral ground
4/10/24	50002	-6.570	-6.77	-0.200	Sidewalk
4/10/24	50003	-6.829	-6.77	0.059	Lawn
4/10/24	50004	-7.619	-6.77	0.849	ROW
4/10/24	50005	-7.701	-6.77	0.931	Tree
4/10/24	50006	-7.075	-6.77	0.305	Driveway



\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_TM2.1_MAPS\TM2.1_FIG.3-1.A.APRX 7/5/2024 1:45 PM

LEGEND

- Observed Water Mark
- Lakeview H&H Study Boundary

Maximum Depth (ft)

- 0.0 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- > 3.0

N

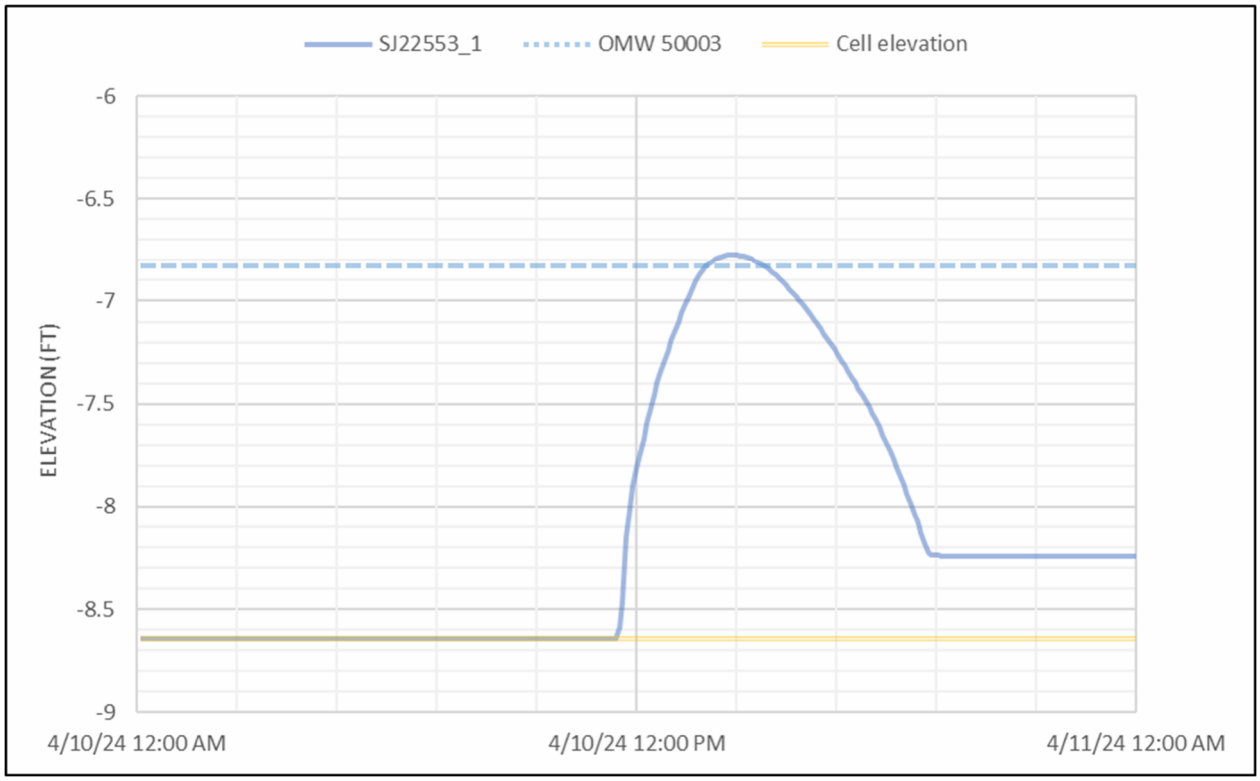
0 0.13 0.25 0.5 Miles

Figure 3-16:
April 10, 2024 Flood Extent and OWM
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

An example of graphical visualization is shown in Figure 3-17. The 50003 OWM point is located on 6770, Marshall Foch. At this point the OWM elevation was 0.06 ft lower than the modelled peak. All OWM to modeled time series comparisons are shown in Appendix G.1 for April 2024.

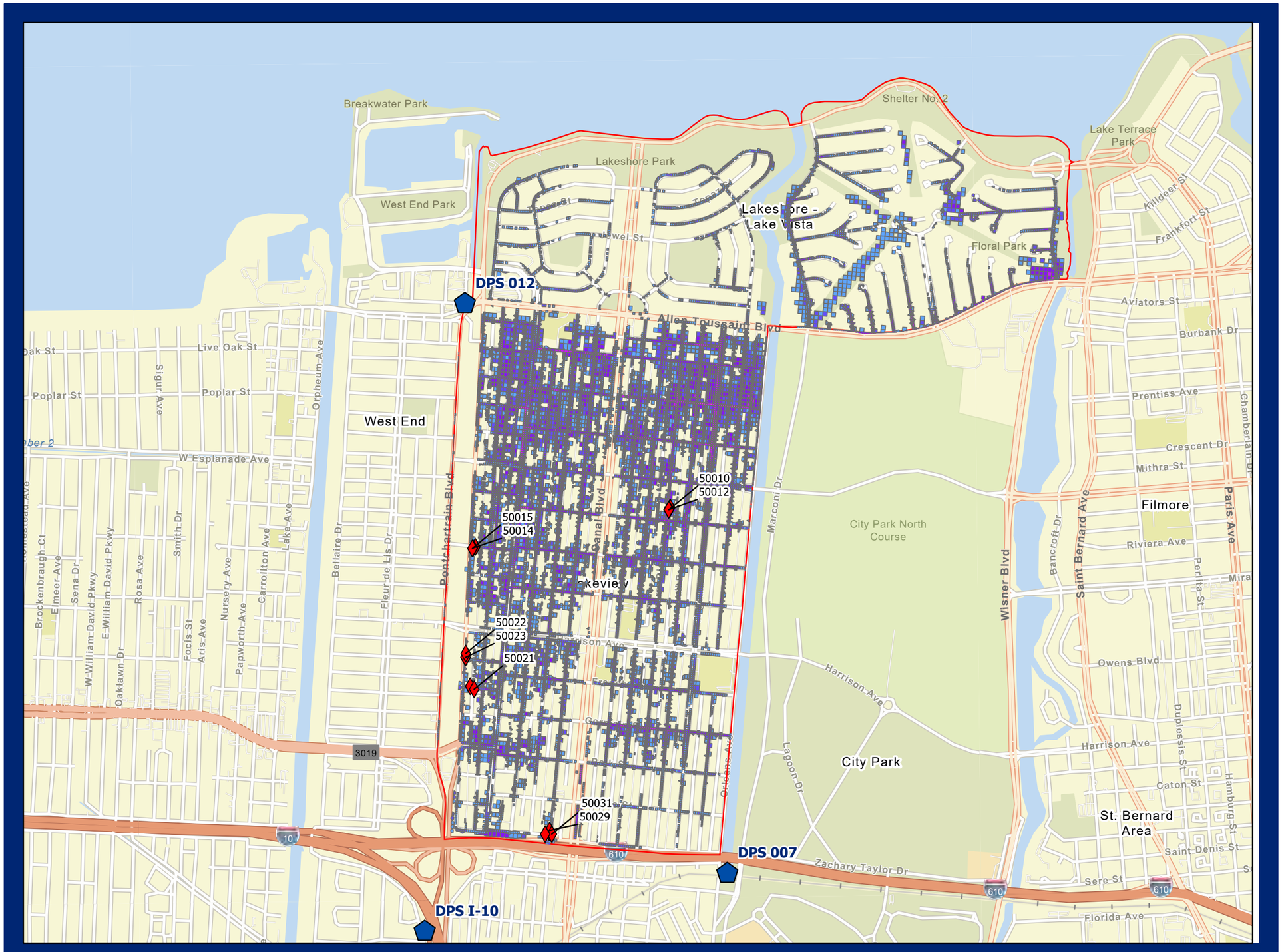
Figure 3-17 Validation Efforts Example – Point 50003 OWM Elevation and WSE Timeseries Comparison for April 2024 Event

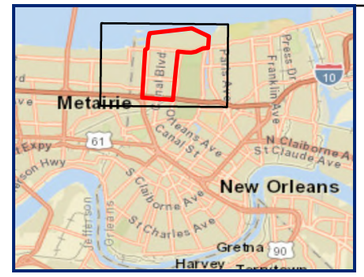


Note: Corresponding 2D cell in the model (SJ22613_1)

3.4.2. September 4, 2023 Validation Efforts

The flood extent of the September 2023 event simulation aligned with the location of the OWM points. All OWM points, apart from three, were located within or on the edge of the flood extent, as shown in Figure 3-18.





LEGEND

- Observed Water Mark
- Lakeview H&H Study Boundary

Maximum Depth (ft)

- 0.0 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- > 3.0

N

0 0.13 0.25 0.5 Miles

Figure 3-17:
September 4, 2023Flood Extent and OWM
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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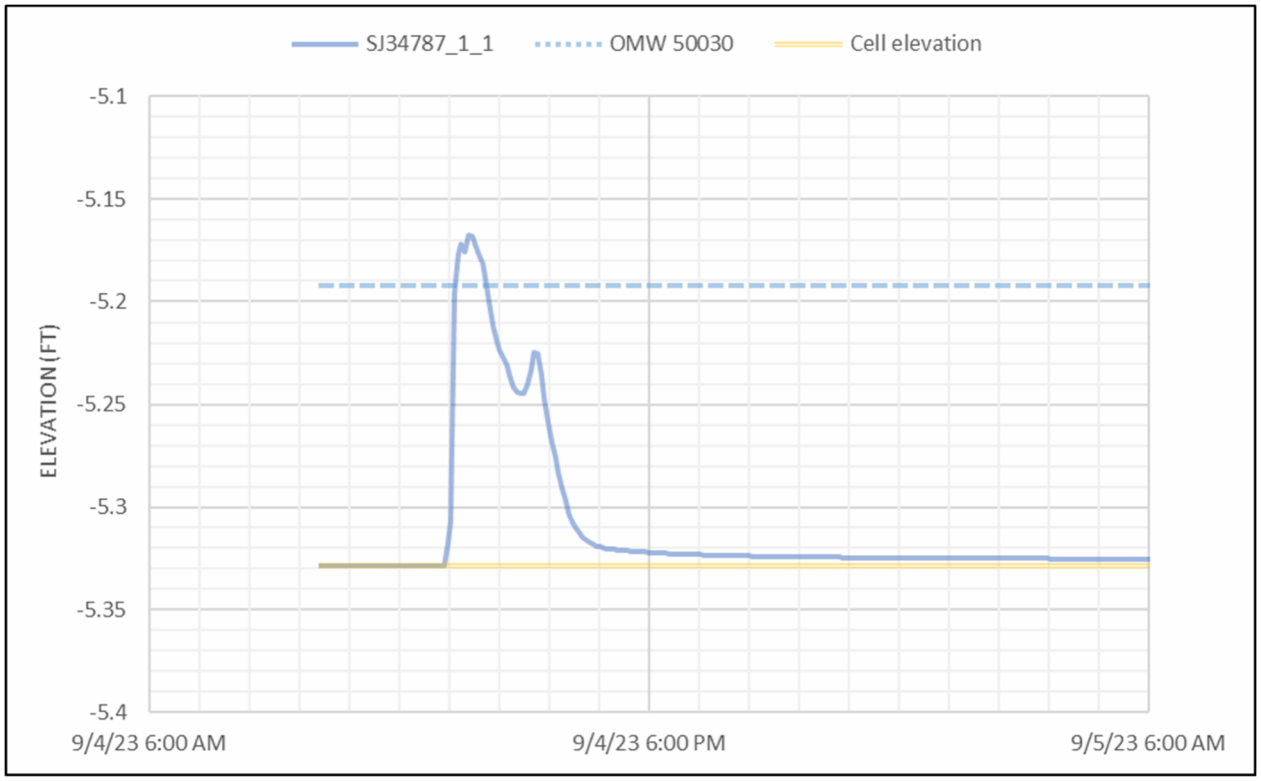
Direct comparison of the modelled maximum WSE at the location of OWM points confirms that the results are conservative, and the model shows slightly greater flood depths. Calculated differences were in a range of 0.32 – 1.93 ft, with the average of 0.86 ft and most locations having a difference lower than 1 ft, as detailed in Table 3-7.

Table 3-7. Validation Results for 4 September 2023 event

Event	ID	OWM (ft)	Max WSE (ft)	Difference (ft)	Description
9/3/23	50024	-6.493	-5.75	0.743	ROW
9/3/23	50023	-6.067	-5.75	0.317	Driveway
9/3/23	50014	-7.245	-6.37	0.875	Sidewalk
9/3/23	50015	-7.172	-6.37	0.802	Sidewalk
9/3/23	50030	-5.192	-5.17	0.022	ROW
9/3/23	50019	-6.301	-5.76	0.541	Sidewalk
9/3/23	50021	-6.300	-5.76	0.54	Driveway
9/3/23	50022	-6.257	-5.75	0.507	Driveway
9/3/23	50008	-7.740	-6.26	1.48	Lawn
9/3/23	50012	-7.941	-6.26	1.681	Sidewalk
9/3/23	50010	-8.194	-6.26	1.934	Sidewalk
9/3/23	50027	-5.400	-	Out of flood extent	Sidewalk
9/3/23	50028	-5.365	-	Out of flood extent	Sidewalk
9/3/23	50029	-5.060	-	Out of flood extent	Sidewalk
9/3/23	50031	-5.242	Point removed – wrong location	-	-
9/3/23	50011	-8.478	Point removed – test point	-	-
9/3/23	50013	-6.752	Point removed – wrong location	-	-

An example of graphical visualization for the September 4, 2023 event is shown in Figure 3-19. The 50030 OWM point located on 535 Kenilworth Street. At this point the OWM elevation was 0.02 ft lower than the modelled peak . All comparisons of OWMs to modeled time series comparisons are shown in Appendix G.2 for September 2023.

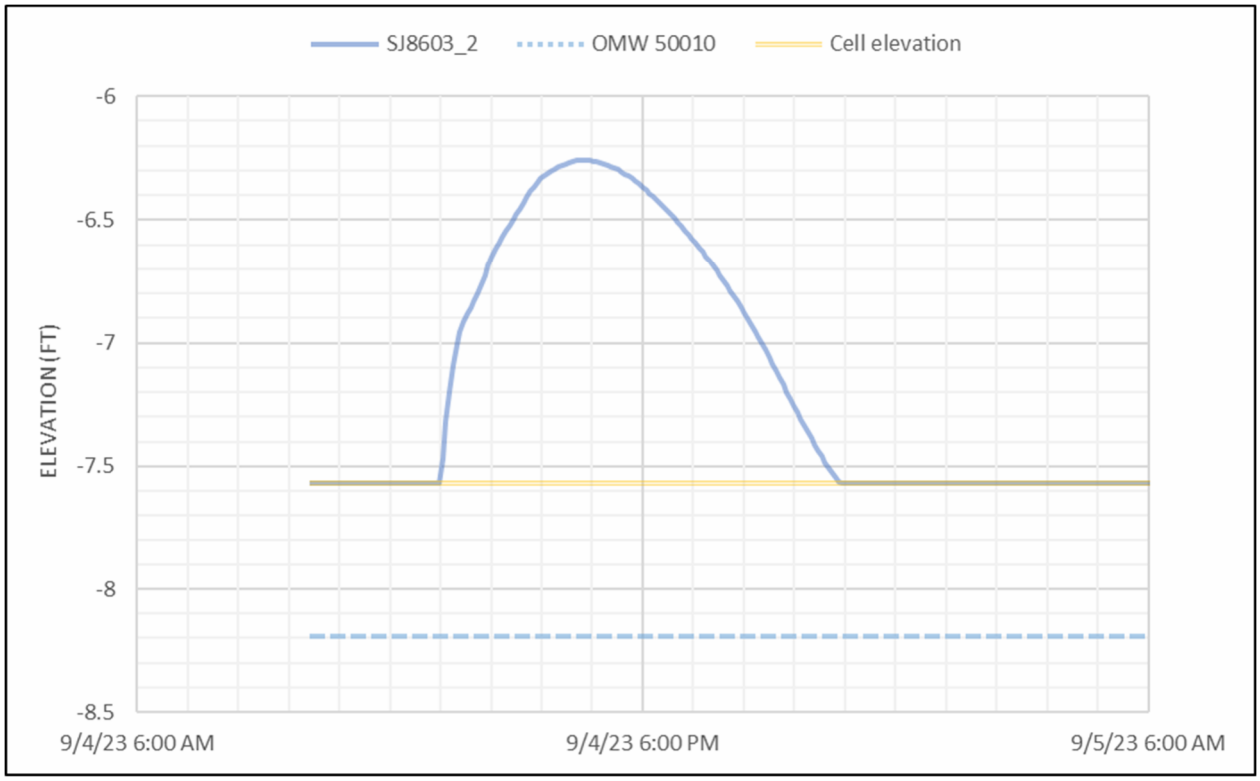
Figure 3-19 Validation Efforts Example – Point 50030 OWM Elevation and WSE Timeseries Comparison for September 2023 Event



Note: Corresponding 2D cell in the model (SJ34787_1_1)

A group of points 50008, 50010 and 50012, showing the biggest differences, were located close to each other at 6628 General Diaz Street. It was noted that OWM elevation for these points were lower than the ground elevation of the model cells (Figure 3-20). This anomaly likely occurred due the following: The cell elevation in PCSWMM is based on sampled elevation from the DTM at the location of 2D nodes. This method does not fully reflect terrain differentiation within the cell, unlike OWM, which were surveyed at exact points. The DTM has a vertical accuracy of 9 cm. Nevertheless, the points are located within the flood extent, indicating that despite discrepancies in elevations at this location, the model accurately shows flooding where it is expected. Similar issue was noticed also with 50022 and 50024 OWM points, located along West End Boulevard (Appendix G).

Figure 3-20 Validation Efforts Example – Point 50010 OWM Elevation and WSE Timeseries Comparison for September 2023 Event



Note: Corresponding 2D cell in the model (SJ8603_2)

4. Model Limitations and Assumptions

The accuracy and validity of the hydraulic model results is dependent on the accuracy of the hydrological and topographic data included in the model. While the most appropriate available information has been used to construct the model, there are uncertainties and limitations associated with the model.

The model was provided by the client with limited information about the detailed parameters used. Efforts have been made to update it with the most up-to-date data to reflect the reality of the system and its conditions. However, there are some elements of the model that have not been changed and may need to be reviewed more closely in future iterations of the modeling effort:

- Entrance and exit losses were remained as per Ardurra model and are assigned to all laterals off the main lines. This includes exit losses at confluences and the inlet downstream of the confluence, which seems to double count losses in these pipes. The current model is already producing conservative results, so the losses were left unchanged.
- In the Ardurra model four outfalls (OutA_CDM, OutB_CDM, OUT_CPGC_CDM, OUT_LLV_46_CDM) had type set to Free and drain to an area covered by the subcatchment SC60, covering the New Orleans City Park. Outfall flows were not routed to either the subcatchment or storage node SC60 despite two of the four outfalls having a notable amount of outflow (~60 and ~90 cfs peaks). Routing this flow to the storage or subcatchment would increase the flow reaching the DPS-07 pump station, which could further increase the water levels in the Lakeview area, which are already conservative. Therefore, the 1D schematization at this location was left unchanged from the Ardurra model. Additionally, to remove the glasswalling, 2D outfalls were added at the edge of the model domain, on the south from the Lake Vista.

The other key assumptions and limitations of the modelling work undertaken are summarized as follows:

- The topographic representation of the 2D model domain is based on the LiDAR DTM flown in 2021. It is therefore dependent on the vertical and horizontal accuracy of the data used.
- Rim elevations have been taken from DTM to avoid discrepancies on the boundary between 1D and 2D and further model instabilities.
- Cell elevation in the 2D model represents the ground elevation, which is assigned basing on sampled elevation from the DTM at the location of 2D nodes. However, this method does accurately reflect terrain differentiation within the cell.
- Geom 3 values for 2D conduits in the model were kept with a value of 2 for all links. This means that 2D conduits have no walls, which means there are no obstructions on either side so water can flow in all directions.
- The impact of sea level rise is not in scope of work for this project. It is also assumed that the sea level change does not impact alternative analysis because of the DPS-12 and DPS-07 pumps operation.
- Removal of the dual drainage overlapping the western edge of the 2D domain caused slightly increased water levels just upstream from the dual drainage area. This approach gives locally conservative results, yet the described location is far from the main project area.
- There are some lines updated in the model basing on data provided by the Batture, where negative slopes persist. This is because Batture was unable to validate invert elevations at all locations due to limited access to some of the manholes. As a results, there are locations, where invert elevations remained unchanged from the Ardurra model, while the parameters of the neighboring manholes have been updated. In this case negative slopes were assumed to be realistic and not edited.
- Pump stations are in evaluation by USACE.

5. Path Forward

The existing conditions PC SWMM model was updated to reflect the current system and develop the baseline model. The model updates are summarized below:

- Topographic updates to reflect the most recent topography, 2012 USACE HSDRRS LiDAR DEM: New Orleans (OCM Partners, 2024). (Section 2.2.1)
- Conversion of the 1D model to 1D/2D with the development of a 2D mesh. (Section 2.2.1)
- Manhole and pipe adjustments based on infrastructure survey performed by Batture, including updates to pipe inverts, dimensions, and shape along the major system with updated inverts generally lower than existing conditions previously in the model. (Section 2.2.2).
- A standardized pump update was not applicable for the development of baseline model as DPS-07 flows were 75% below nameplate capacity and DPS-12 flows were 6% above nameplate capacity. (Section 2.2.3). Pump operations were investigated in calibration and validation.
- NOAA DDF (NOAA, 2018) curves were identified to determine 1-, 10, and 25-year event rainfall totals (Section 2.3)

Following model updates, Jacobs performed model calibration and validation based on the availability of data. Model calibration included both qualitative and quantitative analysis for the April 10, 2024 storm events and validated using the September 4, 2023 event. Rainfall events, analysis, and hyetographs are discussed in Section 3.1.1. Quantitative comparisons included hot spot identification and resident observation depth (Section 3.1.2) and suction level height data from SWBNO (Section 3.1.2). Due to the limited availability of domain-wide data, calibration primarily involved qualitative comparisons between results of inundation depth and extent and prior flooding observations. Careful attention was given to the pump operations (Section 3.1.2) at the time of the event to be used for calibration.

Direct comparison of the modelled maximum WSE at the location of OWM points shows that the results are conservative, and the model generally has greater flood depths than observed. A graphical comparison has been made to understand not only the absolute deviation of the modelled results from values measured, but also to locate the OWM elevation within the hydrograph of the event, as the time of the OWMs during the events are unknown for some photos. The graphical visualization generally concluded the OWM lie within the hydrograph. Overall, reported flooding locations align with areas experiencing greater flood depths in the baseline model results (Figure 3-7). The historically flooded northern sections of General Diaz and Marshall Foch streets (northeastern part of Lakeview) have the maximum flood depths in the baseline model up to 3.15 and 3.78 ft, respectively.

This document is based on the 012 version of the baseline model. Its schematization was further updated, which included minor refinements that were identified through further analysis and review by the project team, as the study has continued into subsequent tasks. These were:

- addition of 2D outfalls at the southern edge of the Lake Vista to remove the glass walling
- trimming the dual drainage conduits that were overlapping with the 2D domain on the border with the West End
- removed HUNAV_12_01_CDM subcatchment from the 2D domain area, which is located within the Mid City and will be covered by the CDM Smith model.

The updates mentioned above resulted in a negligible decrease in water levels within the Lakeview area (up to -0.02 ft). As a result, all tables and figures in the report remained unchanged.

Model updates referring to the Road Plans detailed by the City, will be covered in the subsequent version of the model used for the modelling of the BGSI solutions in the Task 3.

6. References

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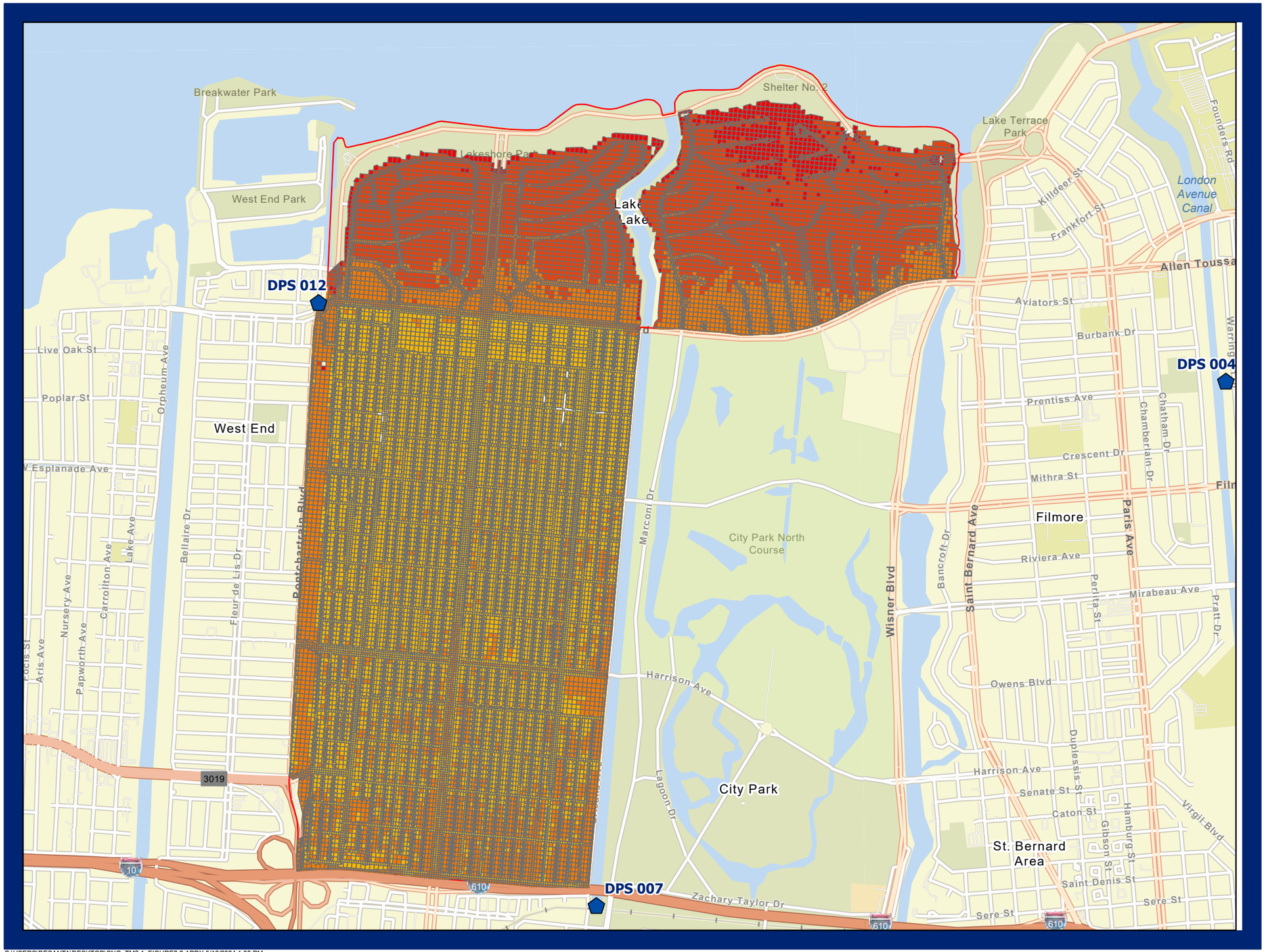
SWBNO, 2024. https://www.swbno.org/Stormwater/Overview

A. Model Log

APPENDIX A. EXISTING CONDITIONS MODEL LOG

ID #	Scenario Name	Climate	Return Period (years)	Event Duration (hours)	Model Run Time (H:M)	Total Precip (in)	Other sensitivity differences	Model updates
ID_1	NO_10Yr_exist_model	Historical	10	36	0:05	8.3	N/A	Model received from Ardurra and run without any updates using PCSWMM Professional 2D 7.6.3675. 10-year event and 24-hour storm duration used. Model 1D only.
ID_2	NO_10yr_2D_012	Historical	10	36	5:25	8.3	N/A	Baseline model run (10-year event and 24-hour storm duration). Model updates included topography adjustment, 2D modelling approach for Lakeview area and major strom drainage system update based on Batture survey (see Sections 2.2.1 and 2.2.2). Pumps start up and shut off depth remained unchanged from the Ardura models. Pump curves for DPS-07 and DPS-12 were adjusted to reach 100% capacity (see Section 3.3).
ID_3	NO_10Apr24_2D_012	Validaton event	10-25 (6-hr event) 5 (24-hr event)	24	4:28	6.5	N/A	Validation model run with April 10, 2024 rainfall event applied. All changes from the baseline model remained unchanged.
ID_4	NO_Sep23_2D_012	Validaton event	25 (6-hr event) 5-10 (24-hr event)	24	6:01	7.59	N/A	Validation model run with September 4, 2023 rainfall event applied. All changes from the baseline model remained unchanged.

B. Surface Adjustment Updates



LEGEND

Lakeview H&H Study Boundary

Elevation (ft)

- < -9
- -9 - -5
- -5 - 0
- 0 - 5
- 5 - 10

0 2.5 5 10 Miles

Appendix B.1:
2D Mesh Elevation

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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LEGEND

- Lakeview H&H Study Boundary

MANNING'S ROUGHNESS

- Road (0.015)
- Green Space (0.05)
- Building (0.1)

0 2.5 5 10 Miles

Appendix B.2:
2D Manning Roughness

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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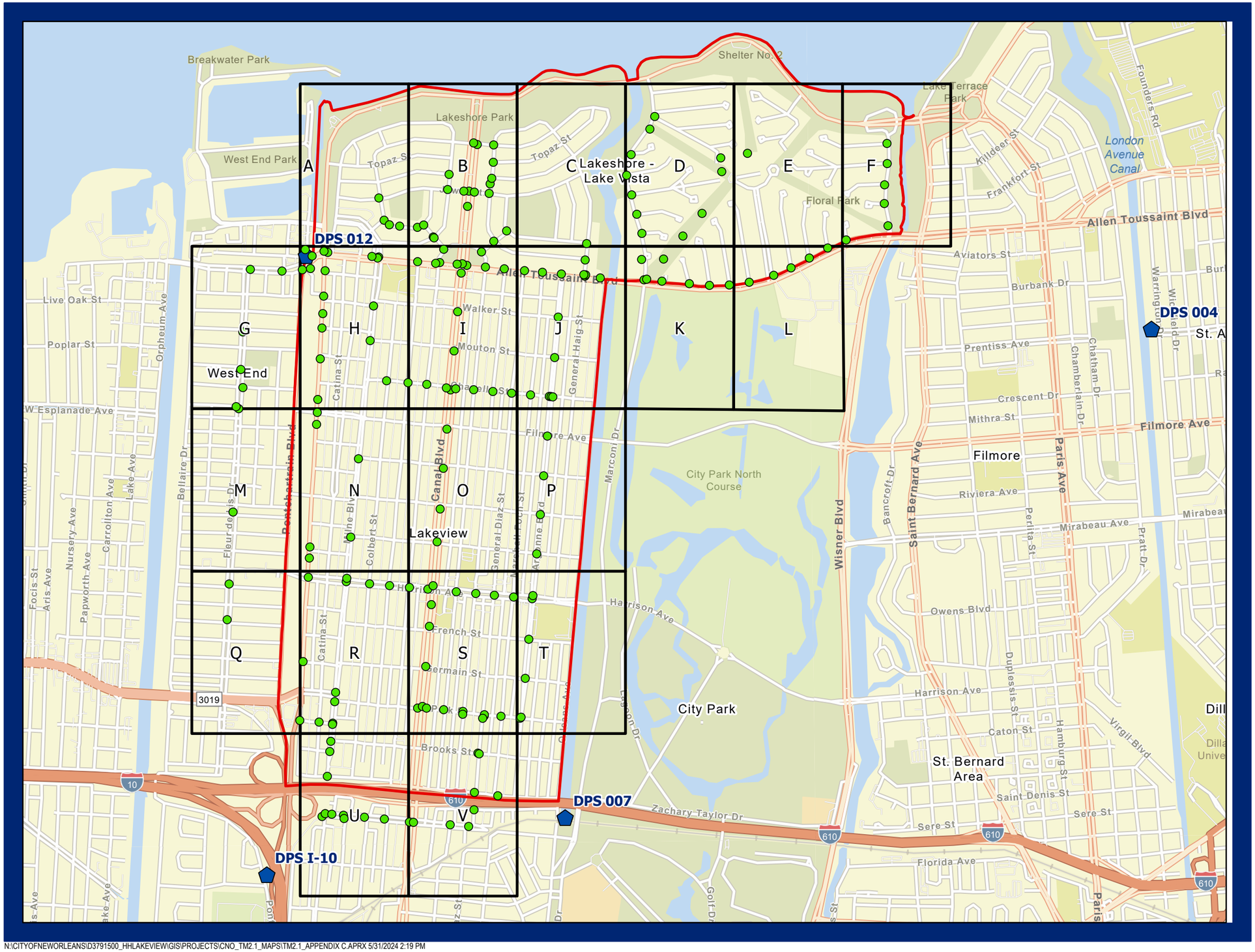
C. Manholes and Pipes Adjustment Updates



LEGEND

- Grid
- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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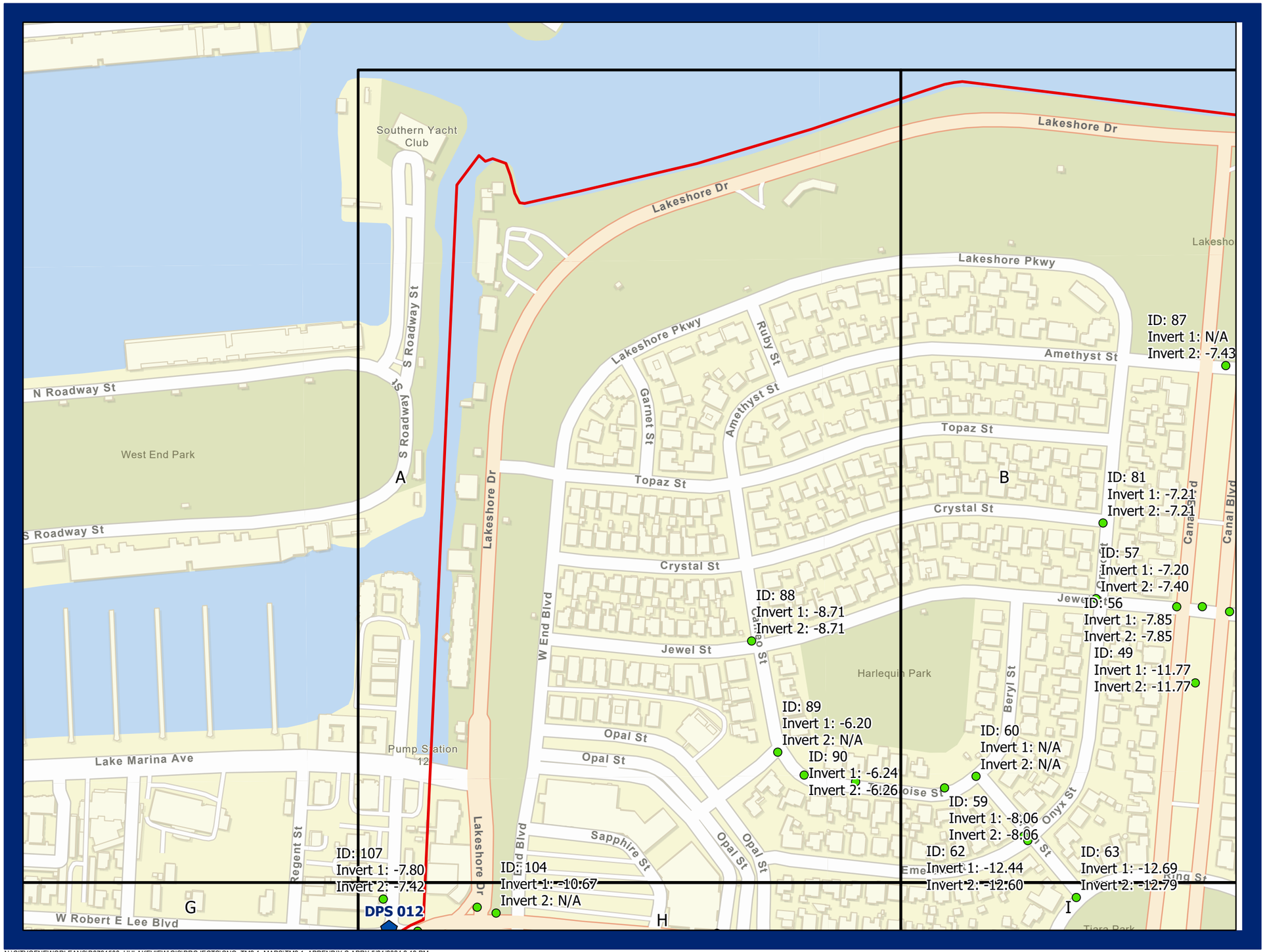

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.A:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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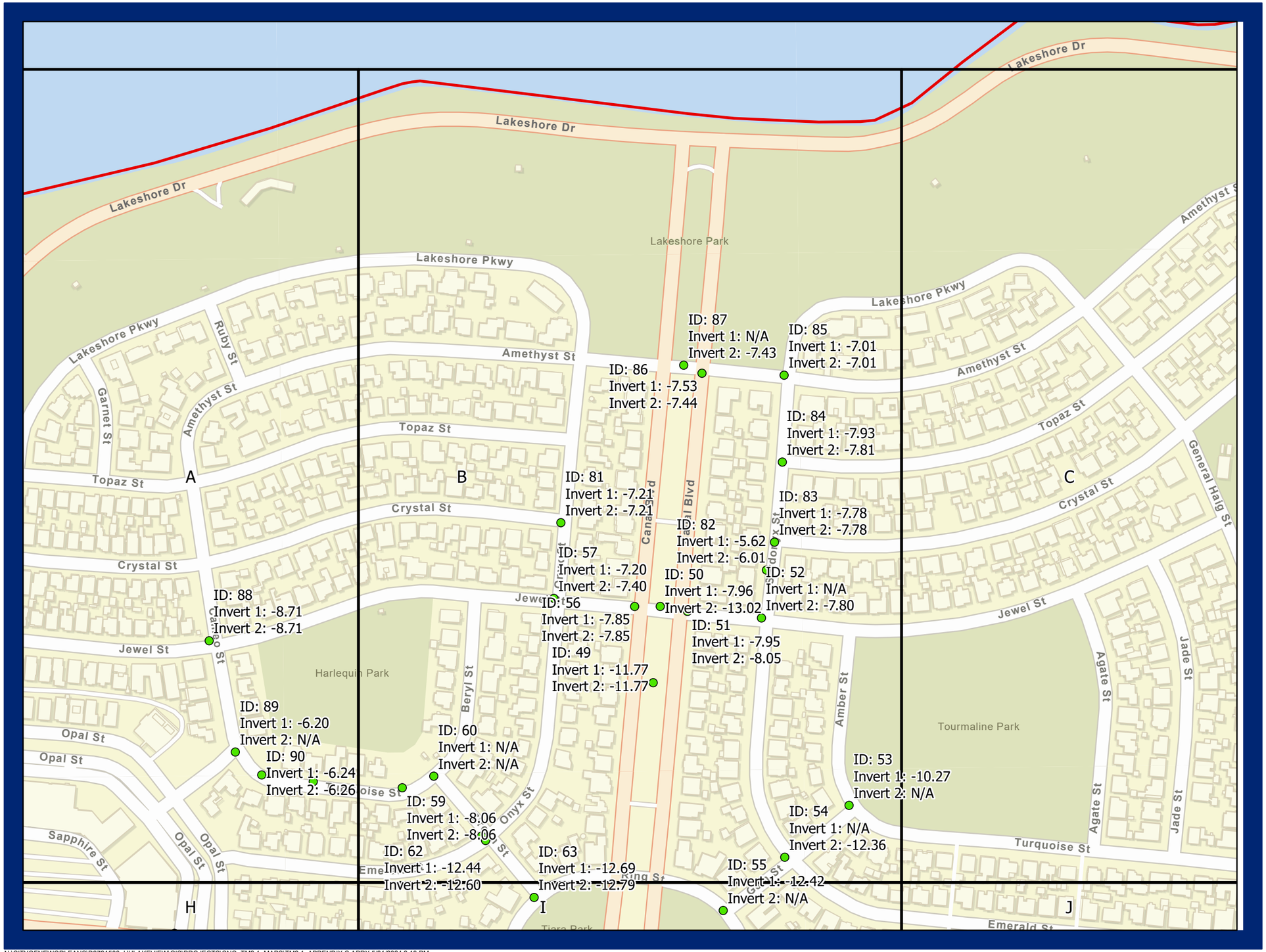

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.B:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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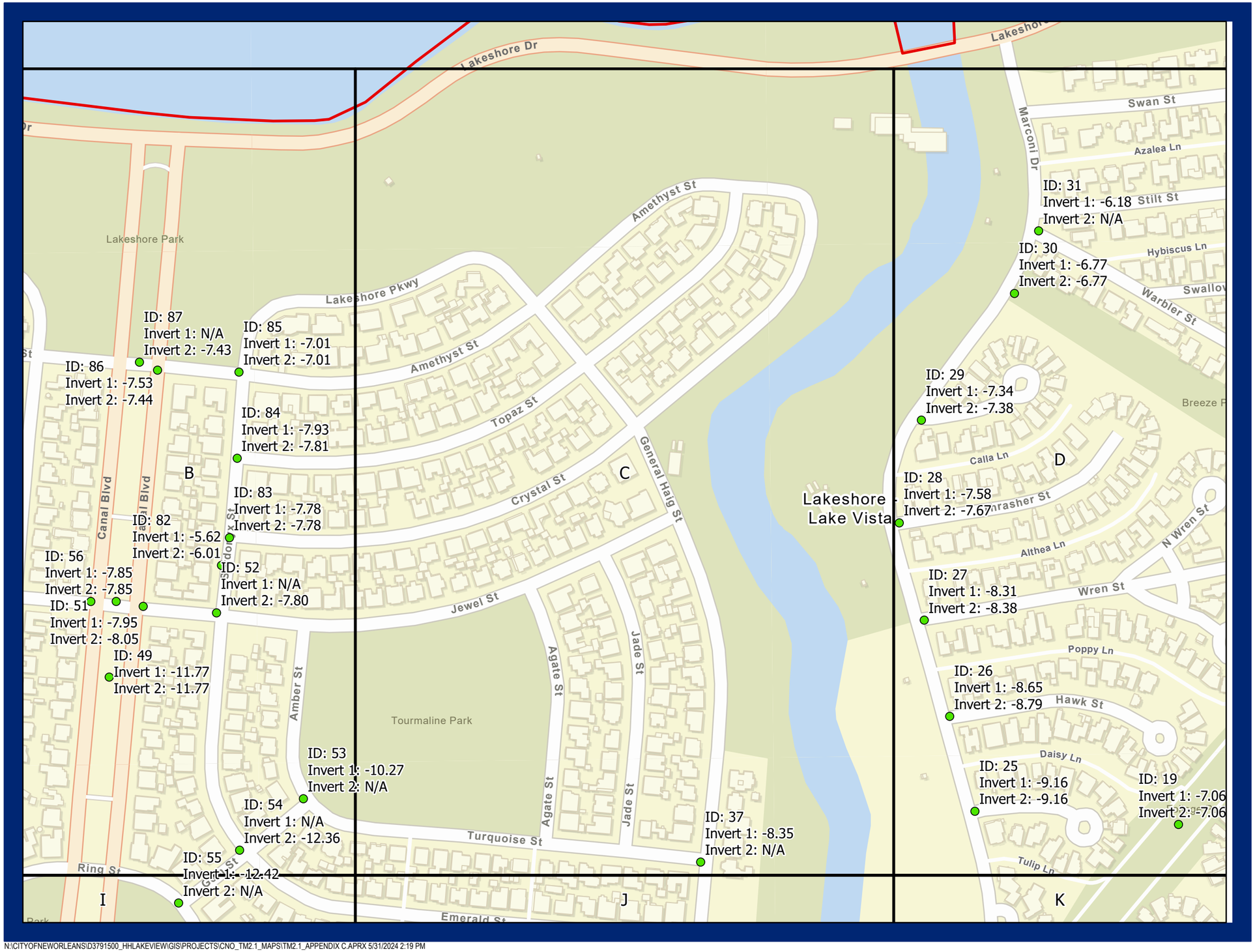

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.C

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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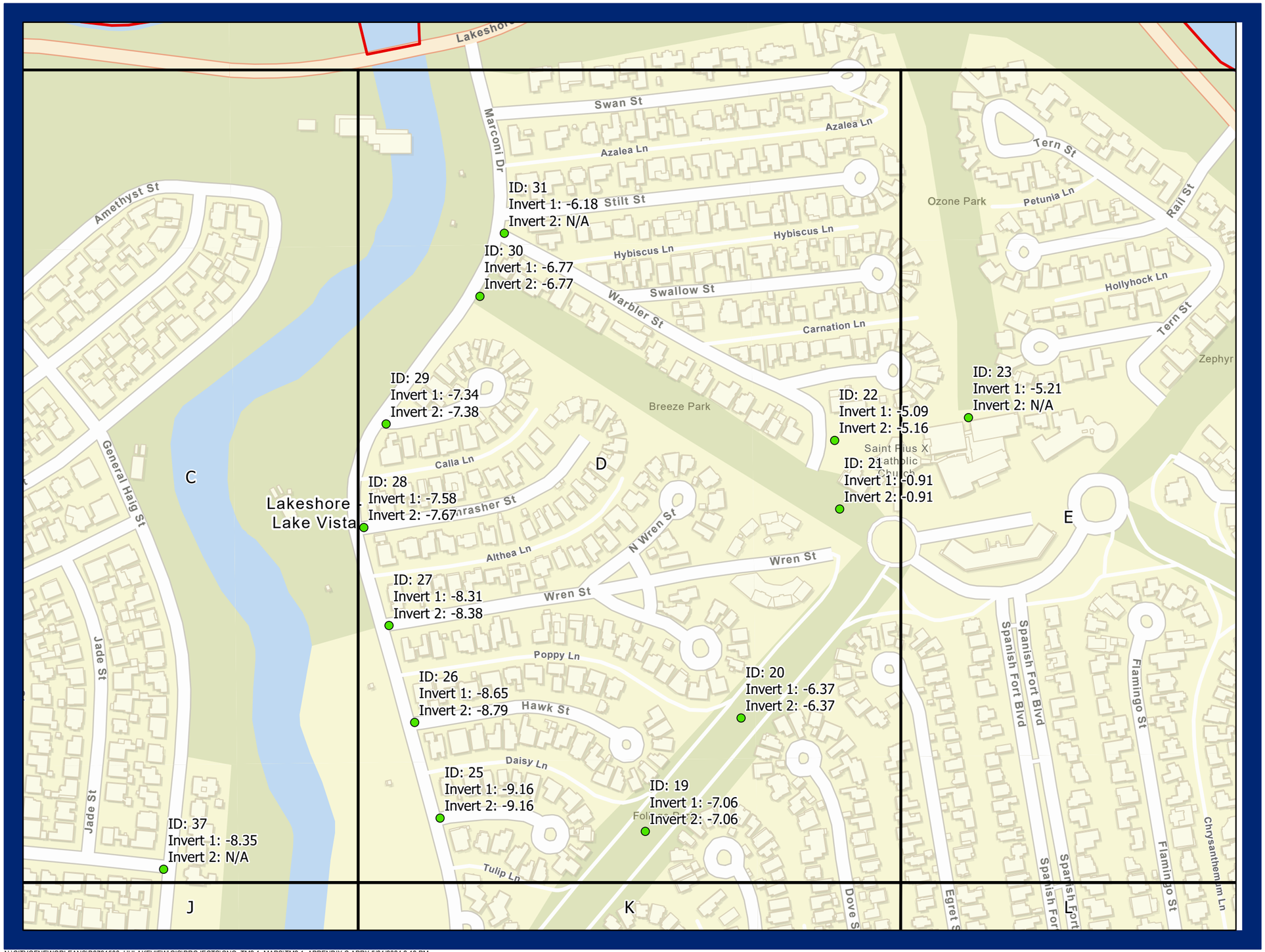

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.D:

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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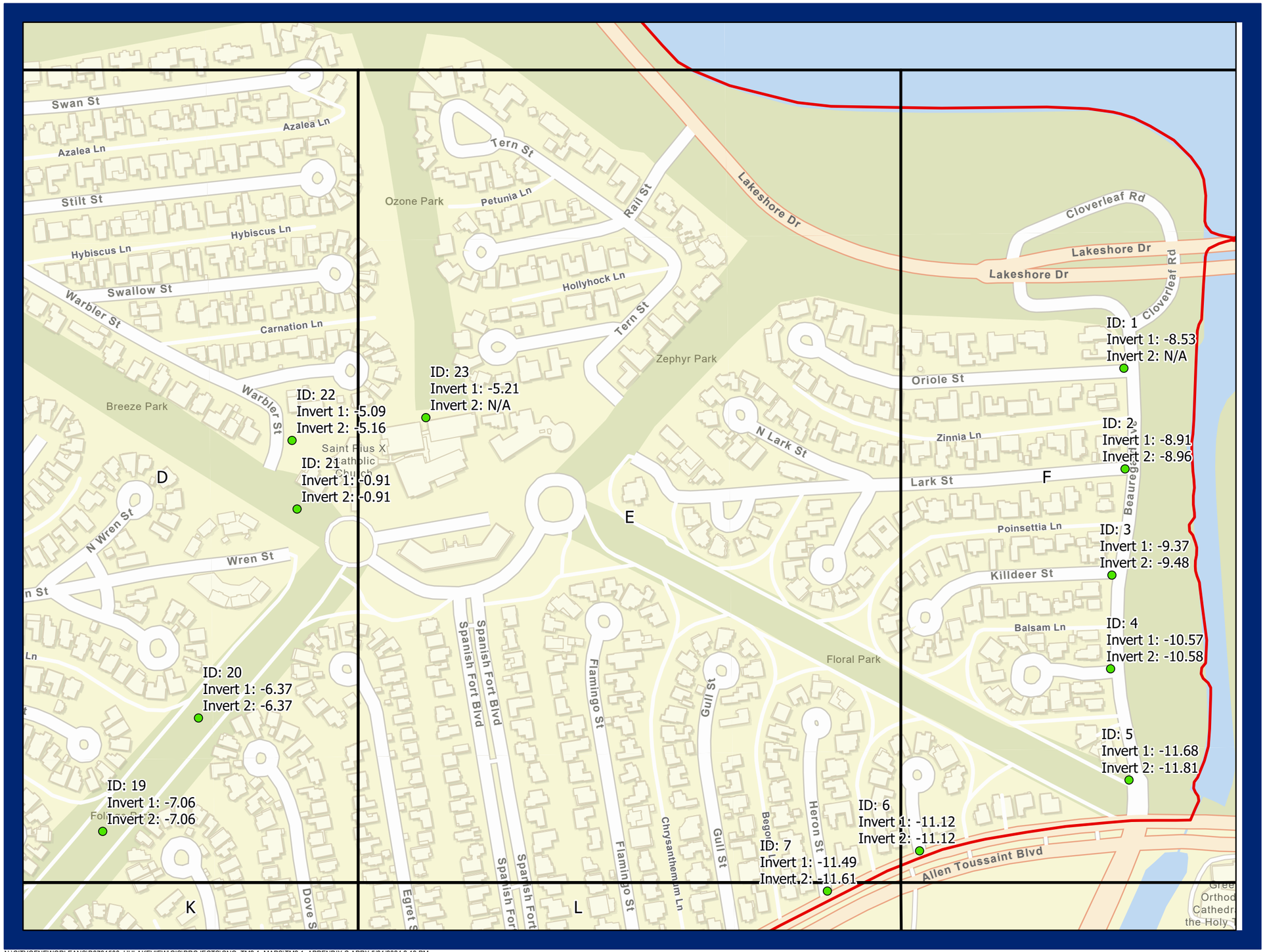

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.E:

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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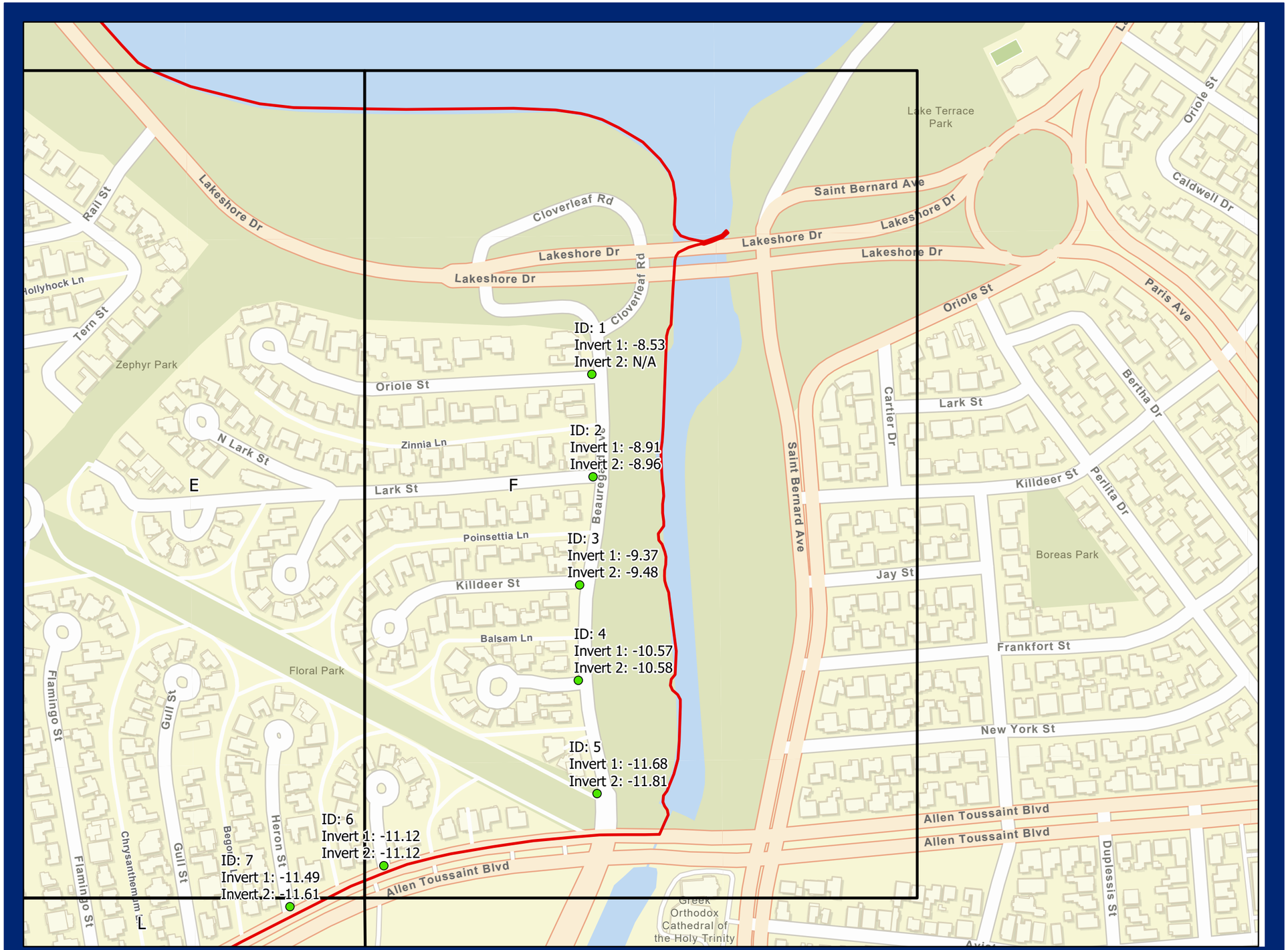

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.F:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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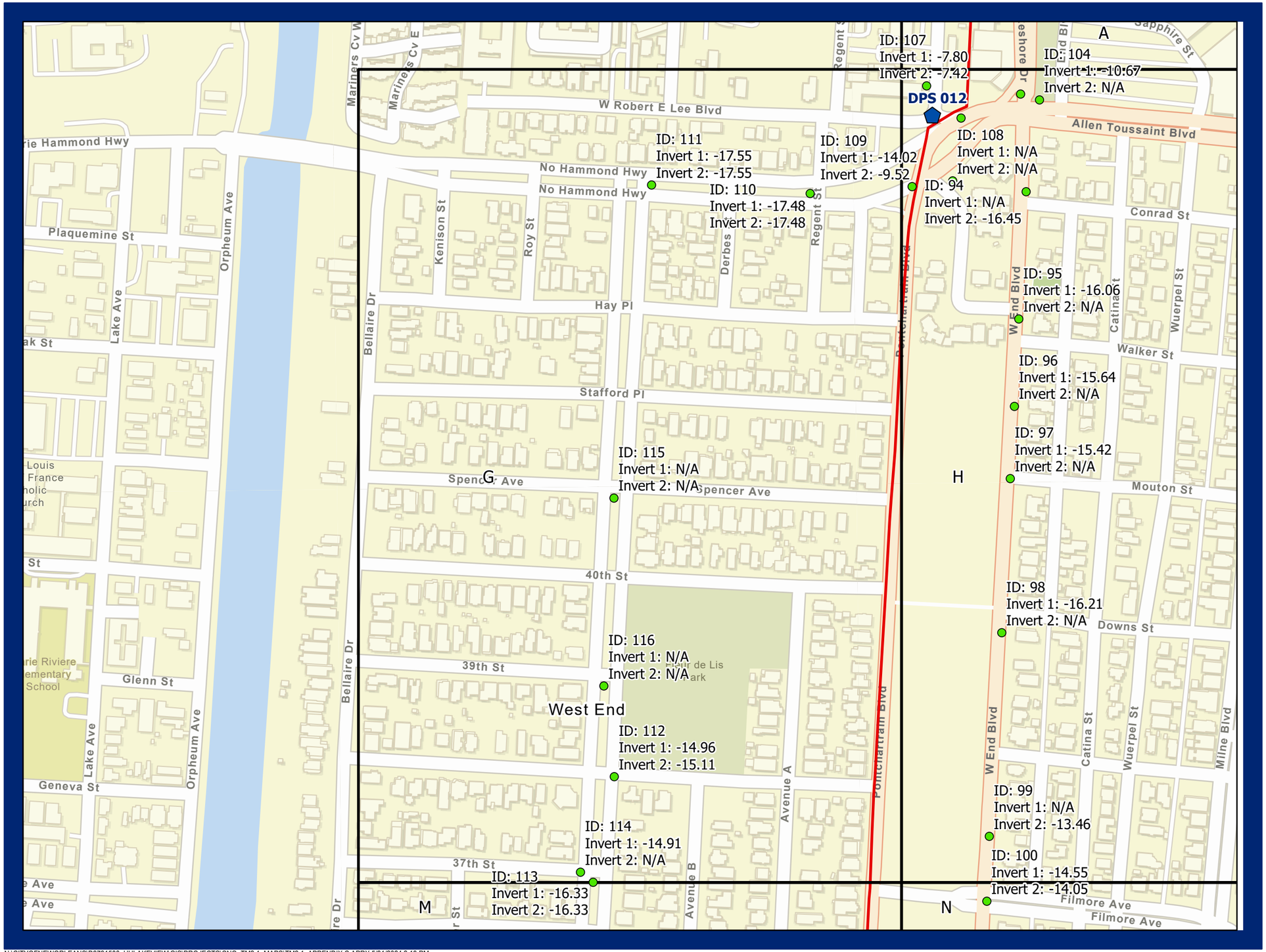

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.G

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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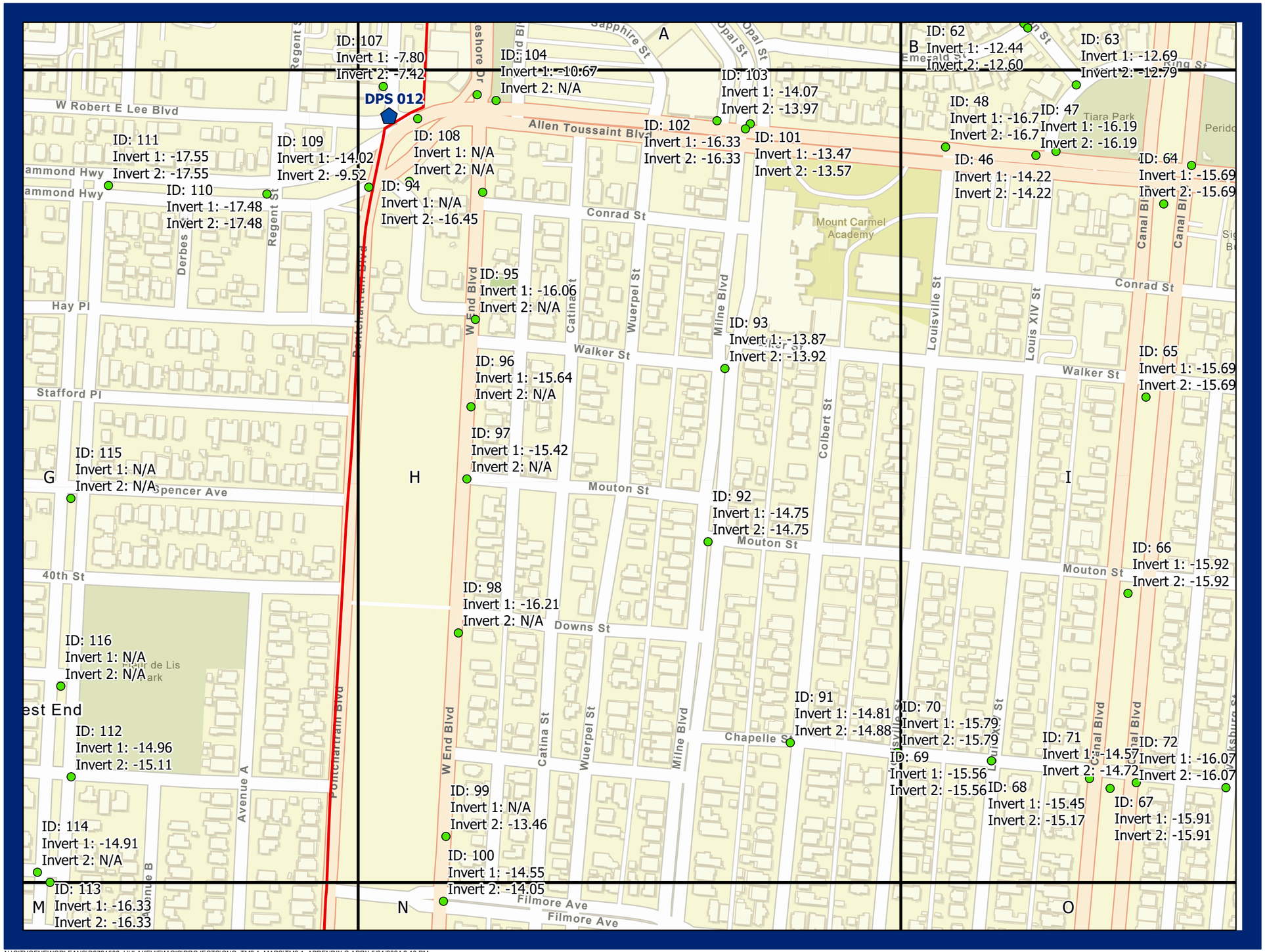

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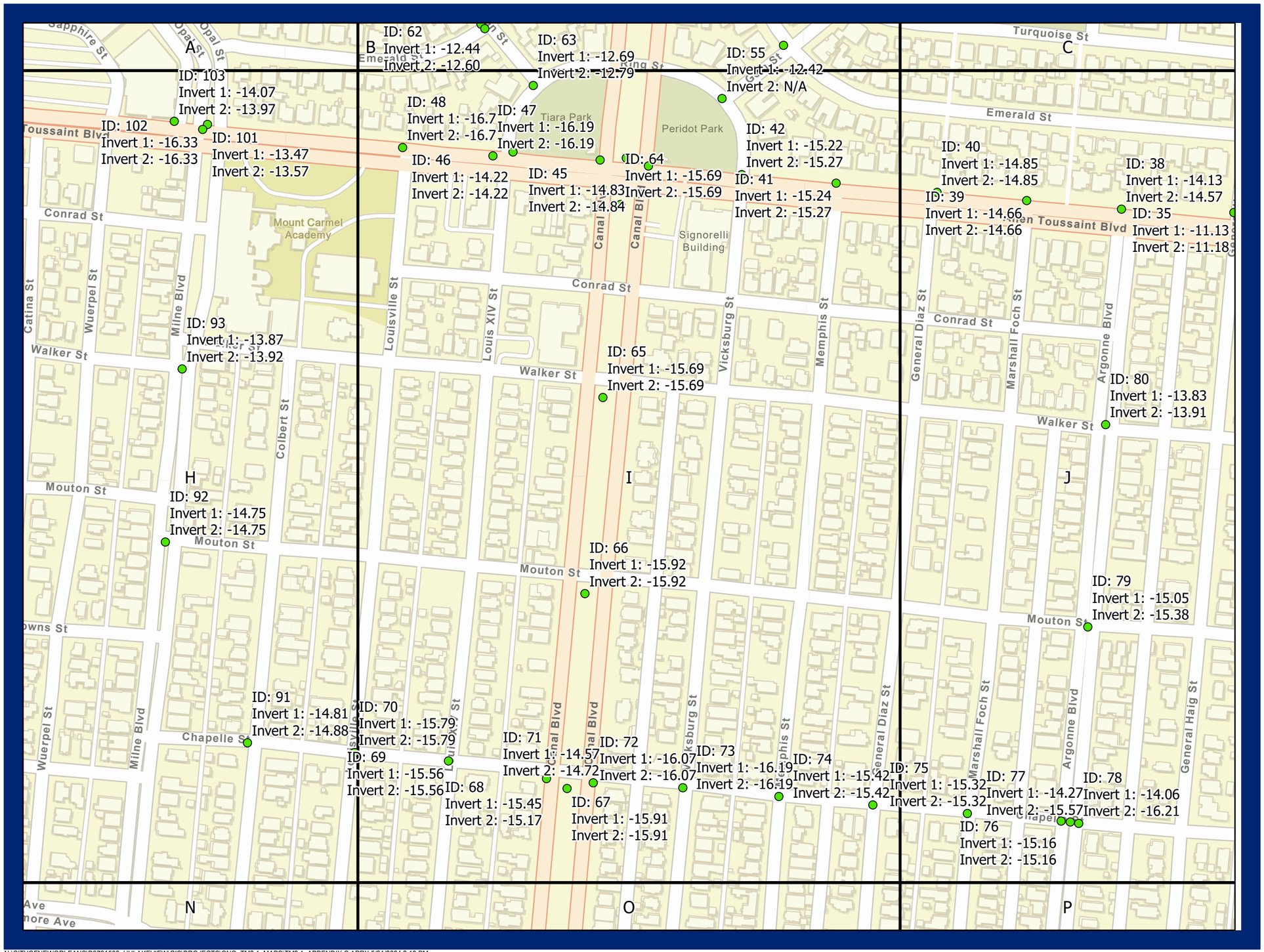
Appendix C.1.H

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs



LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.J :
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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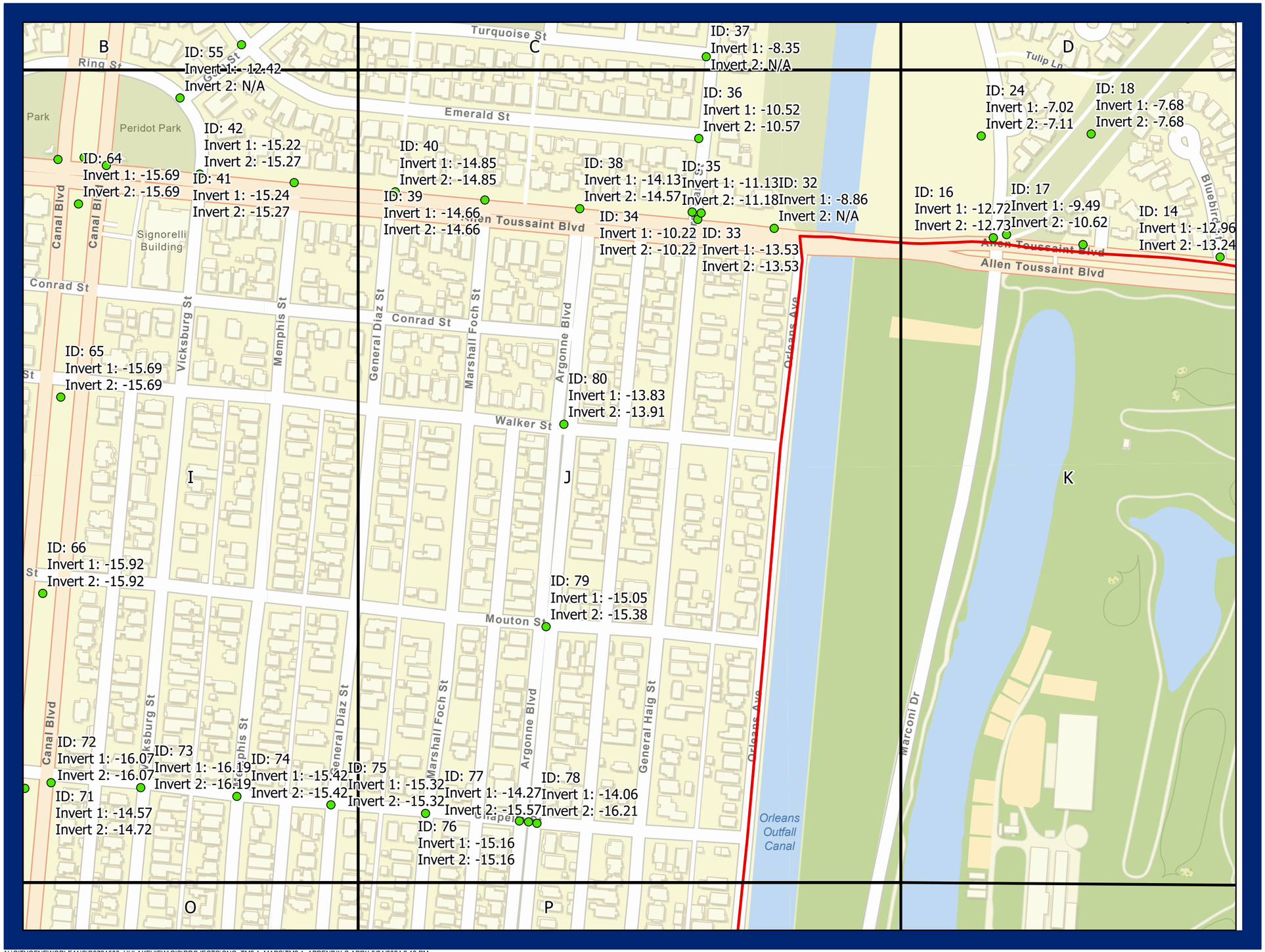

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1J:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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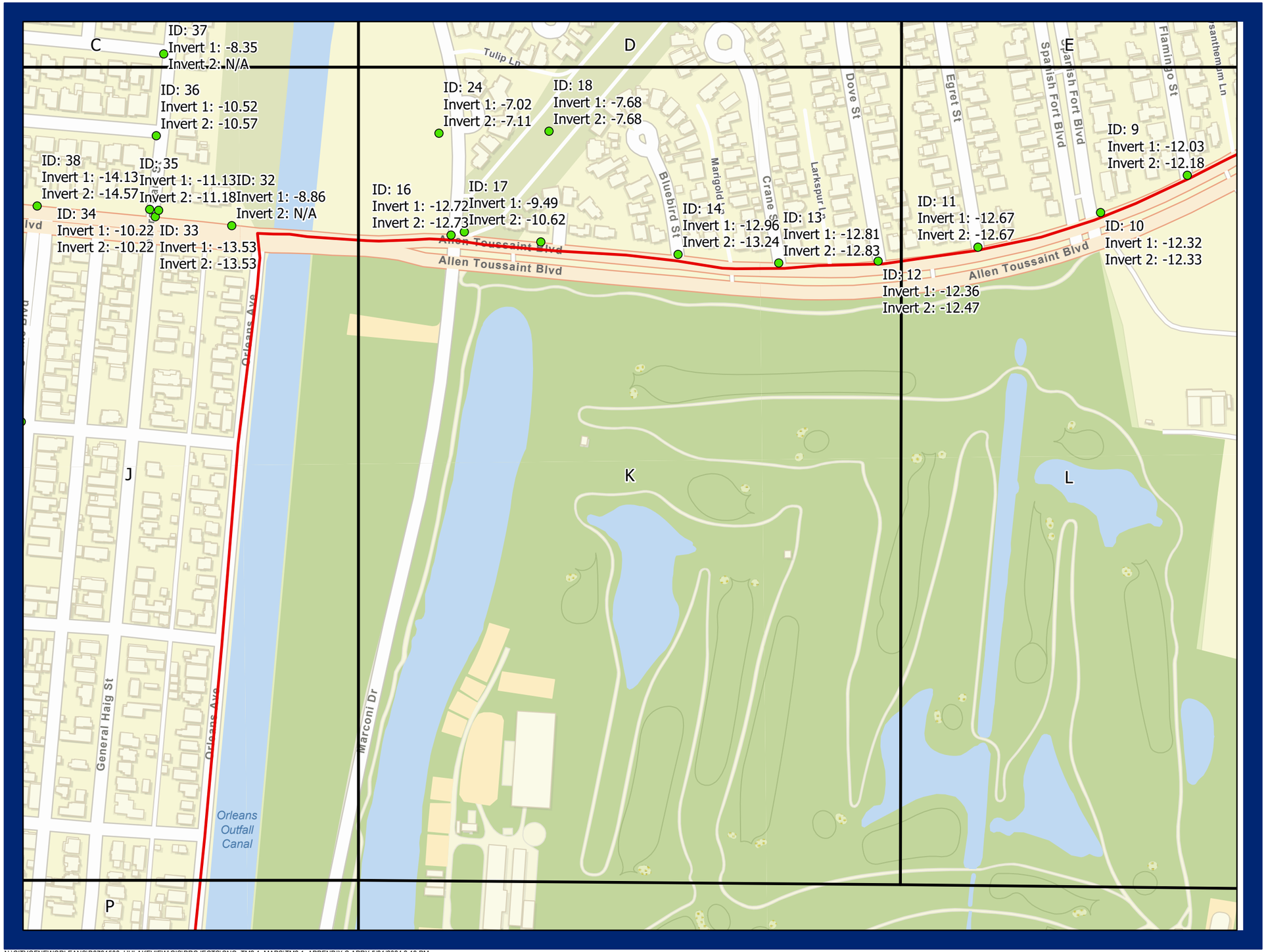

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.K:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1L:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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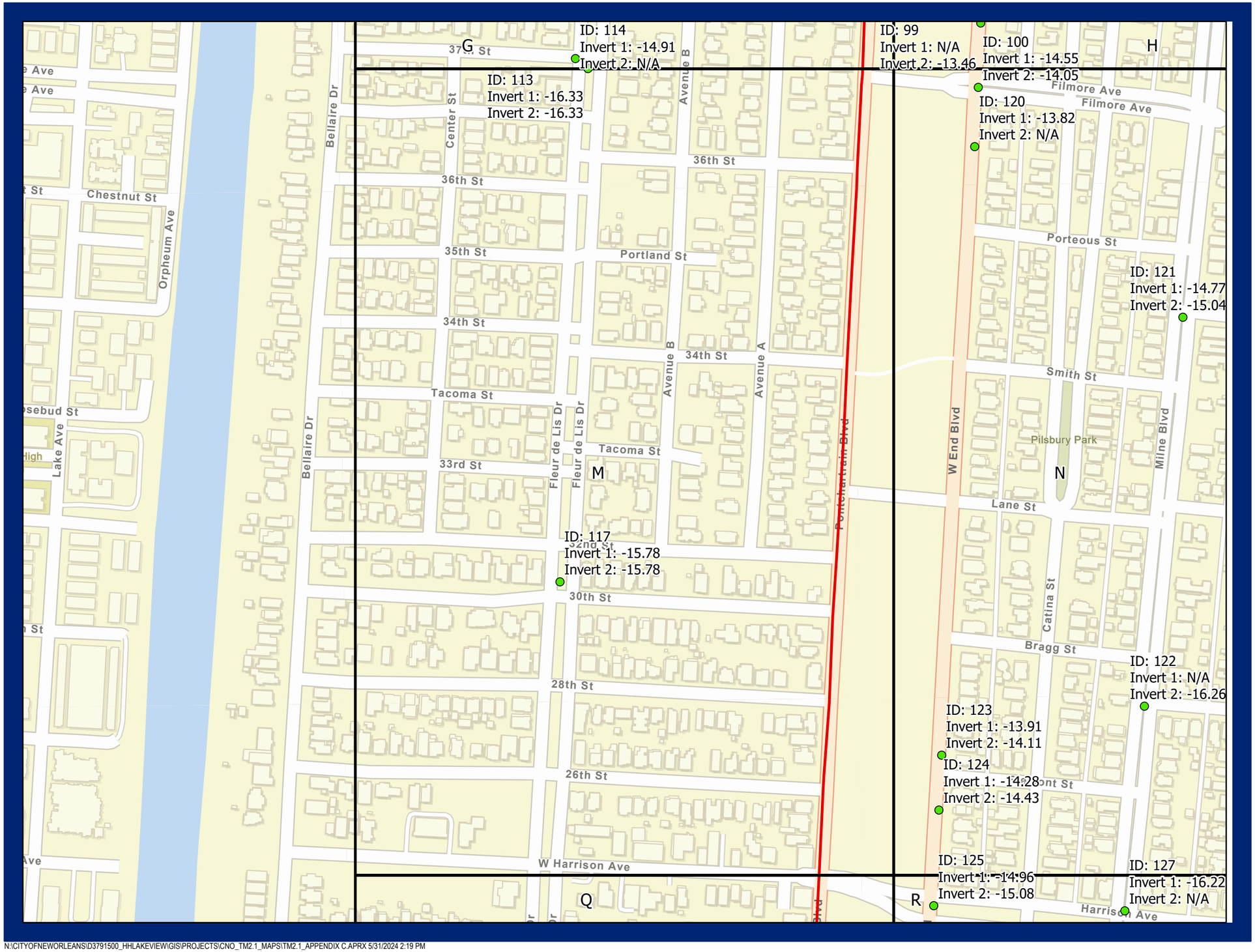

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.M

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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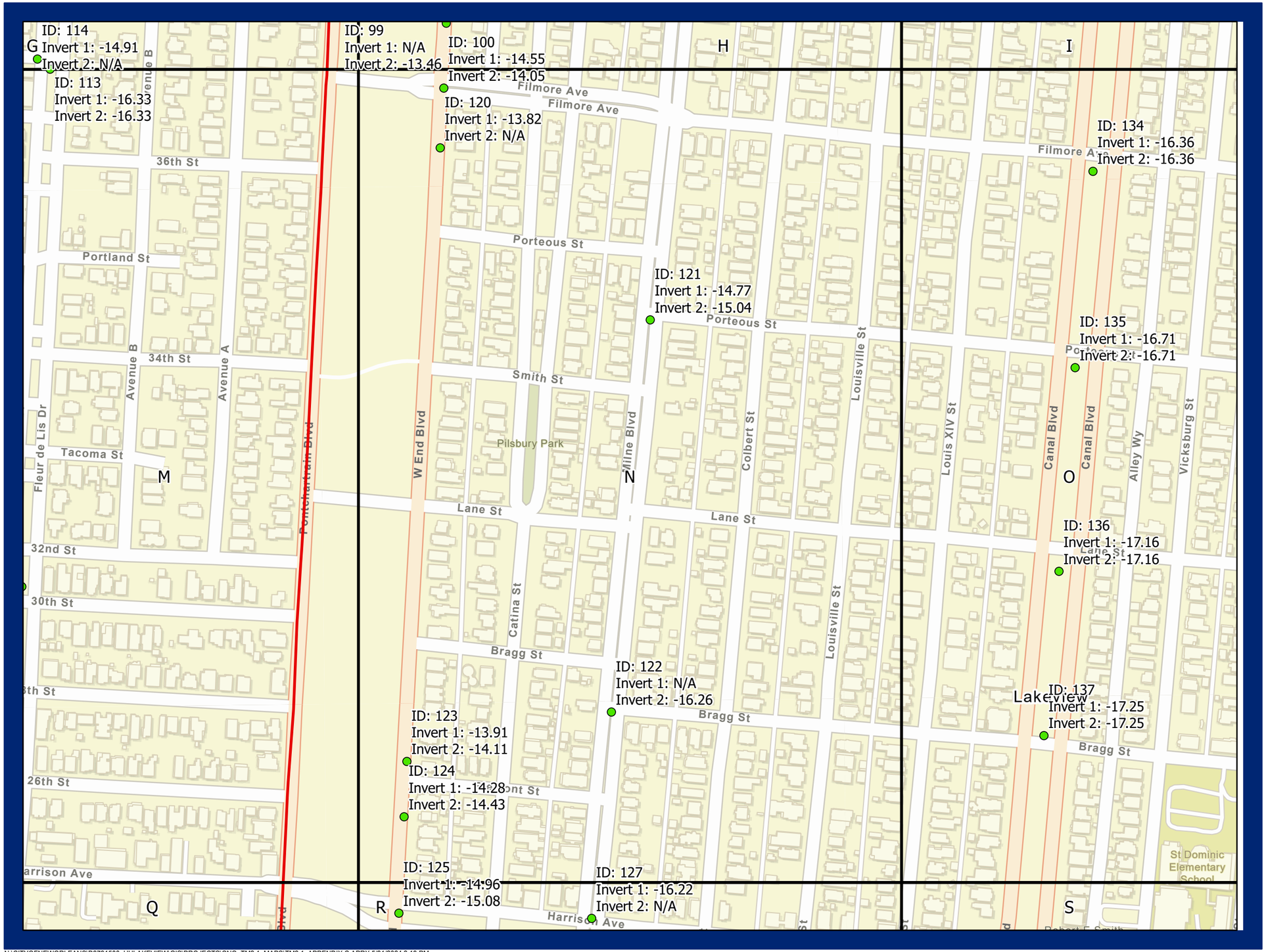

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.N

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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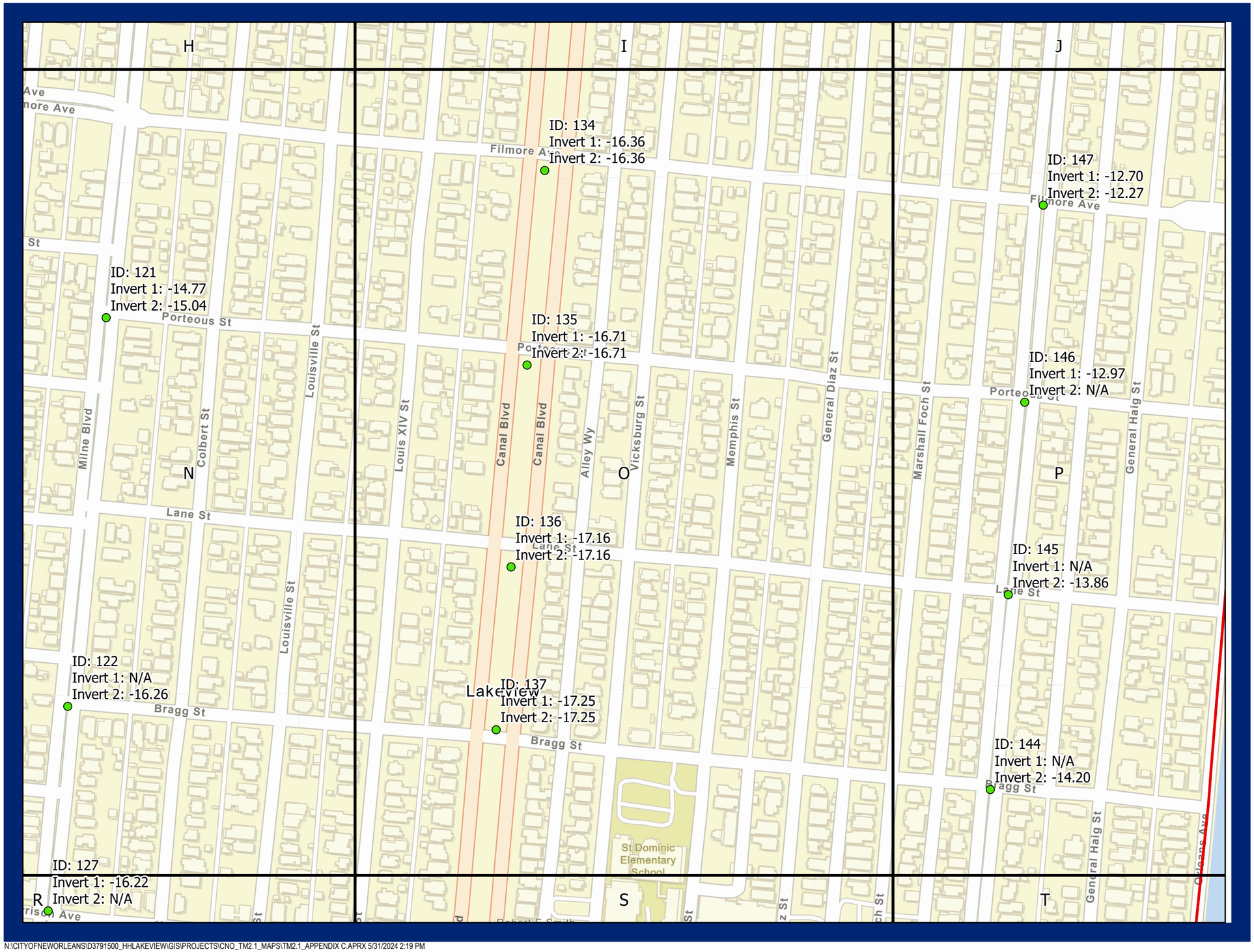

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1Ω

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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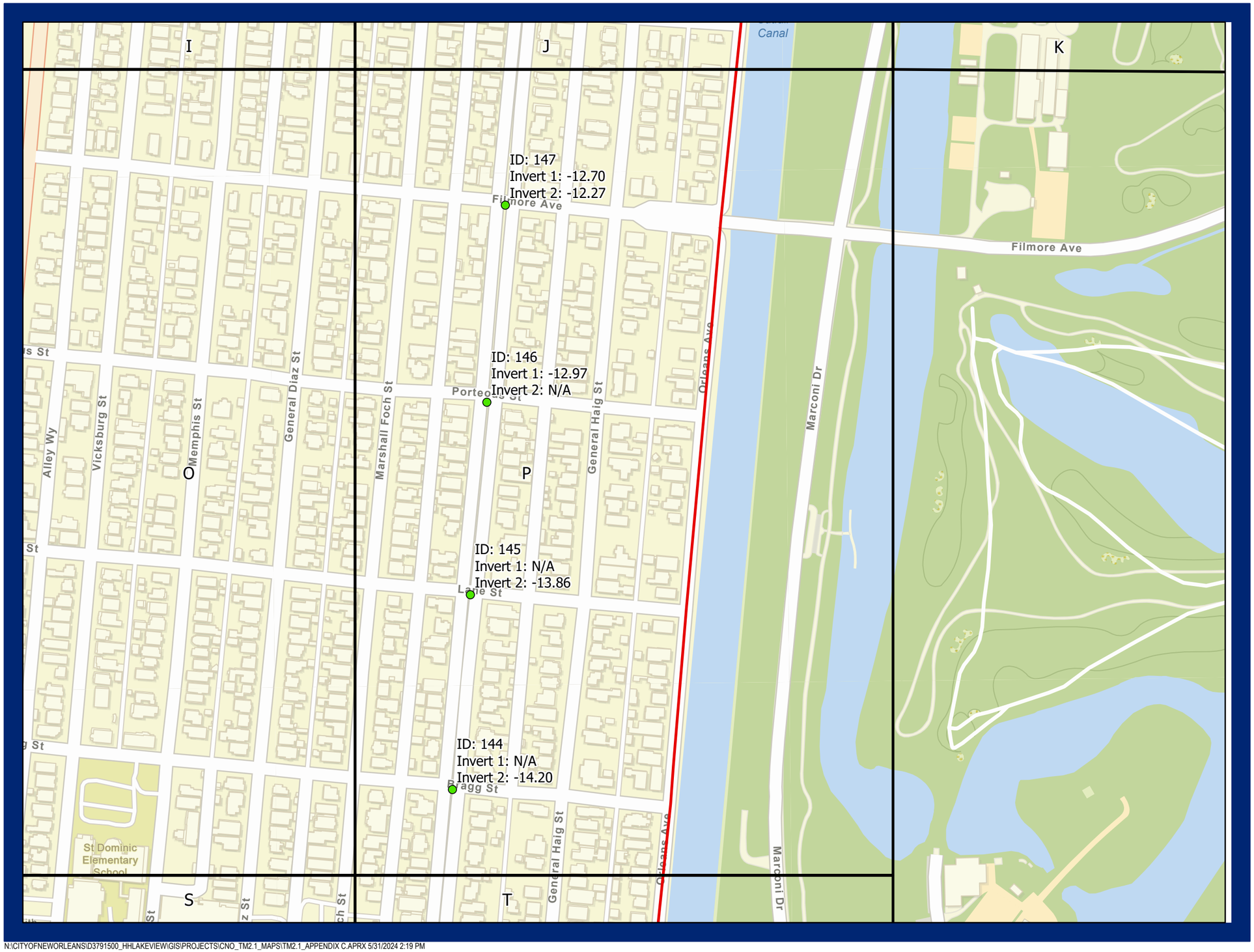

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.P:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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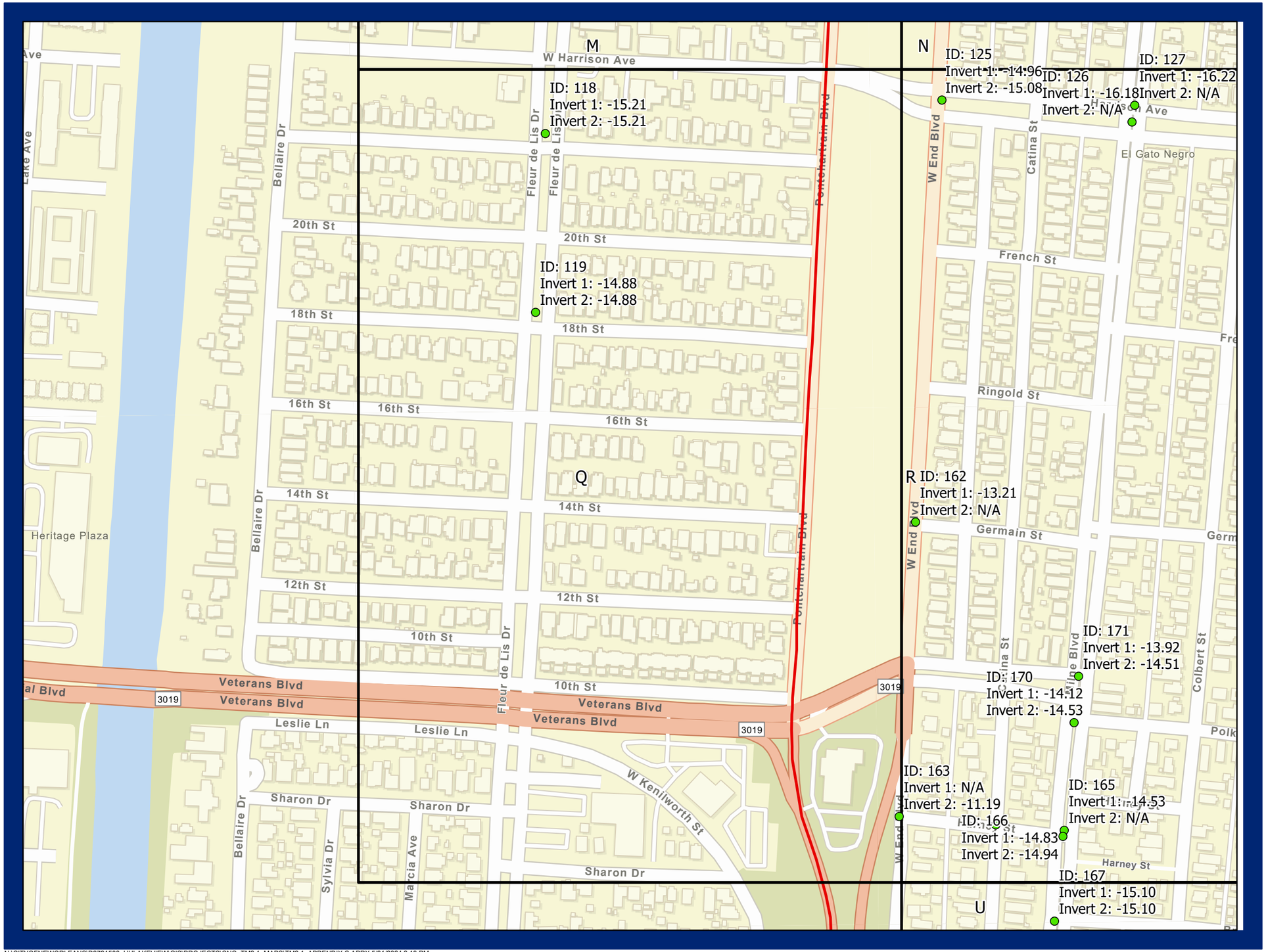

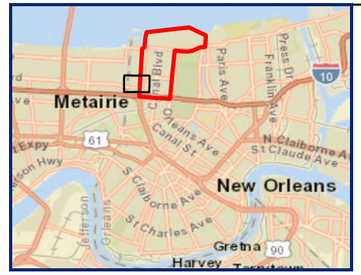

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.Q

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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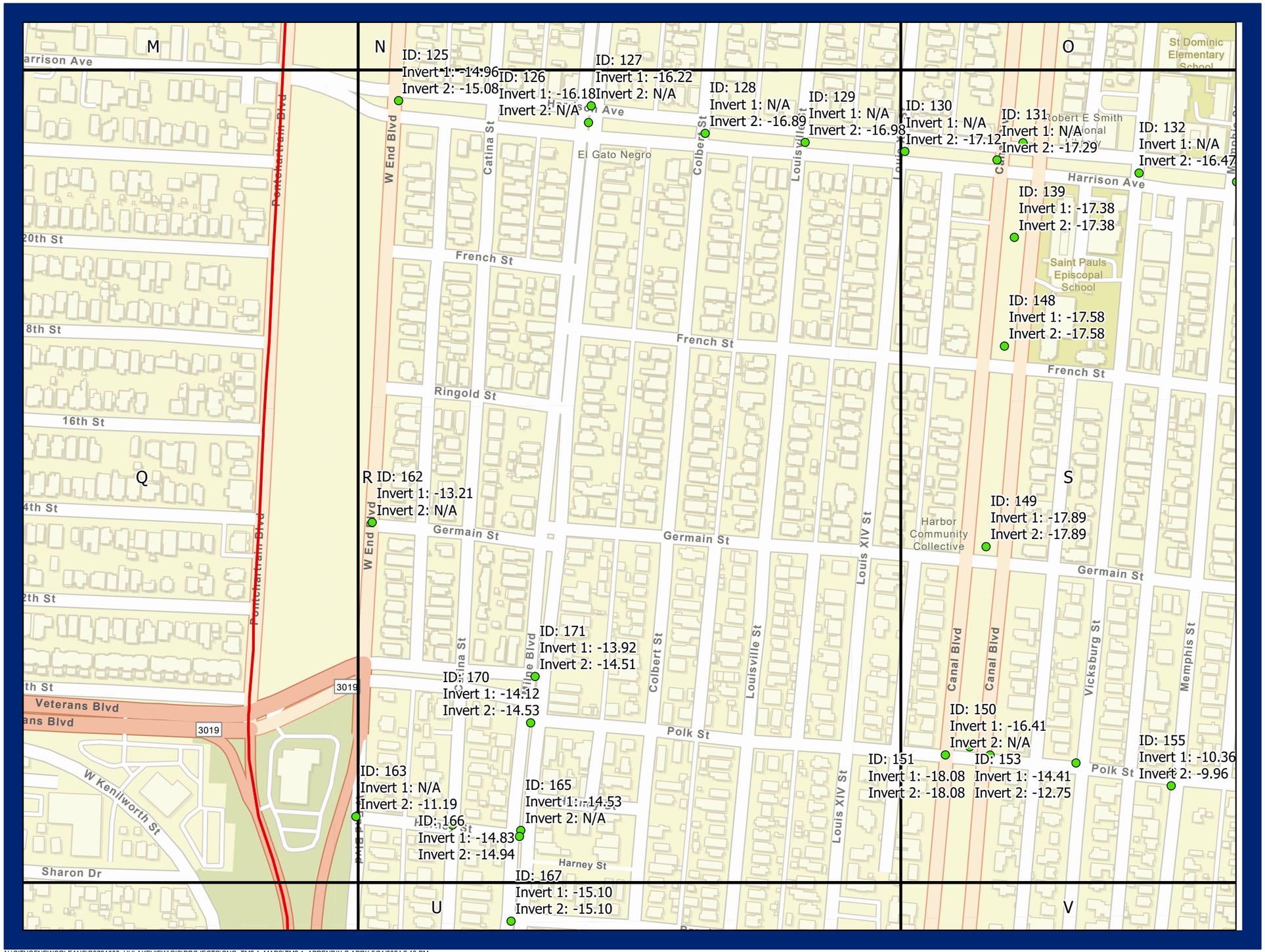

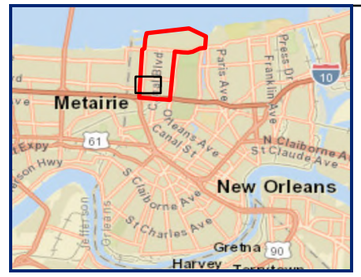

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.R

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.S:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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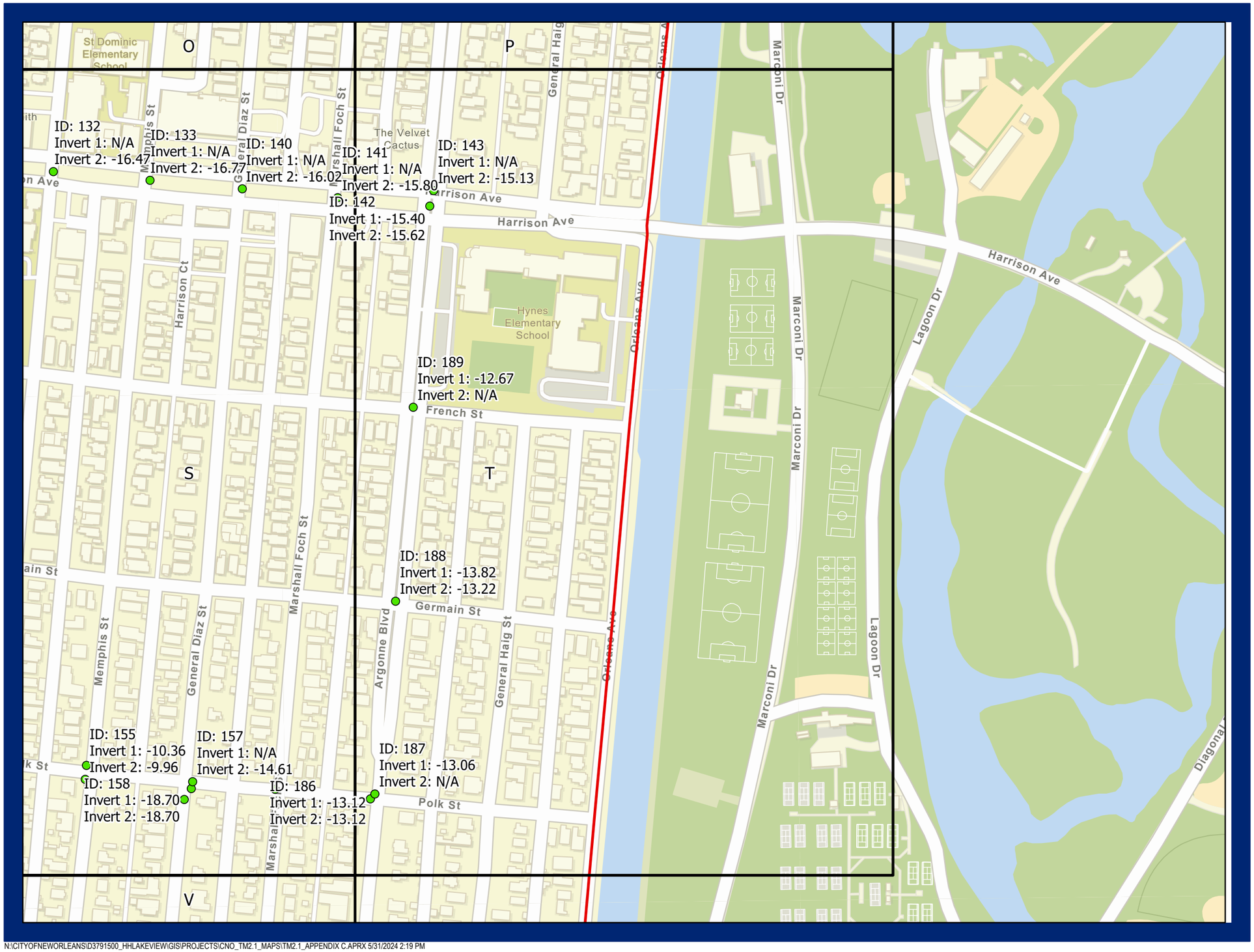

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.T:
Batture Survey Map Elements
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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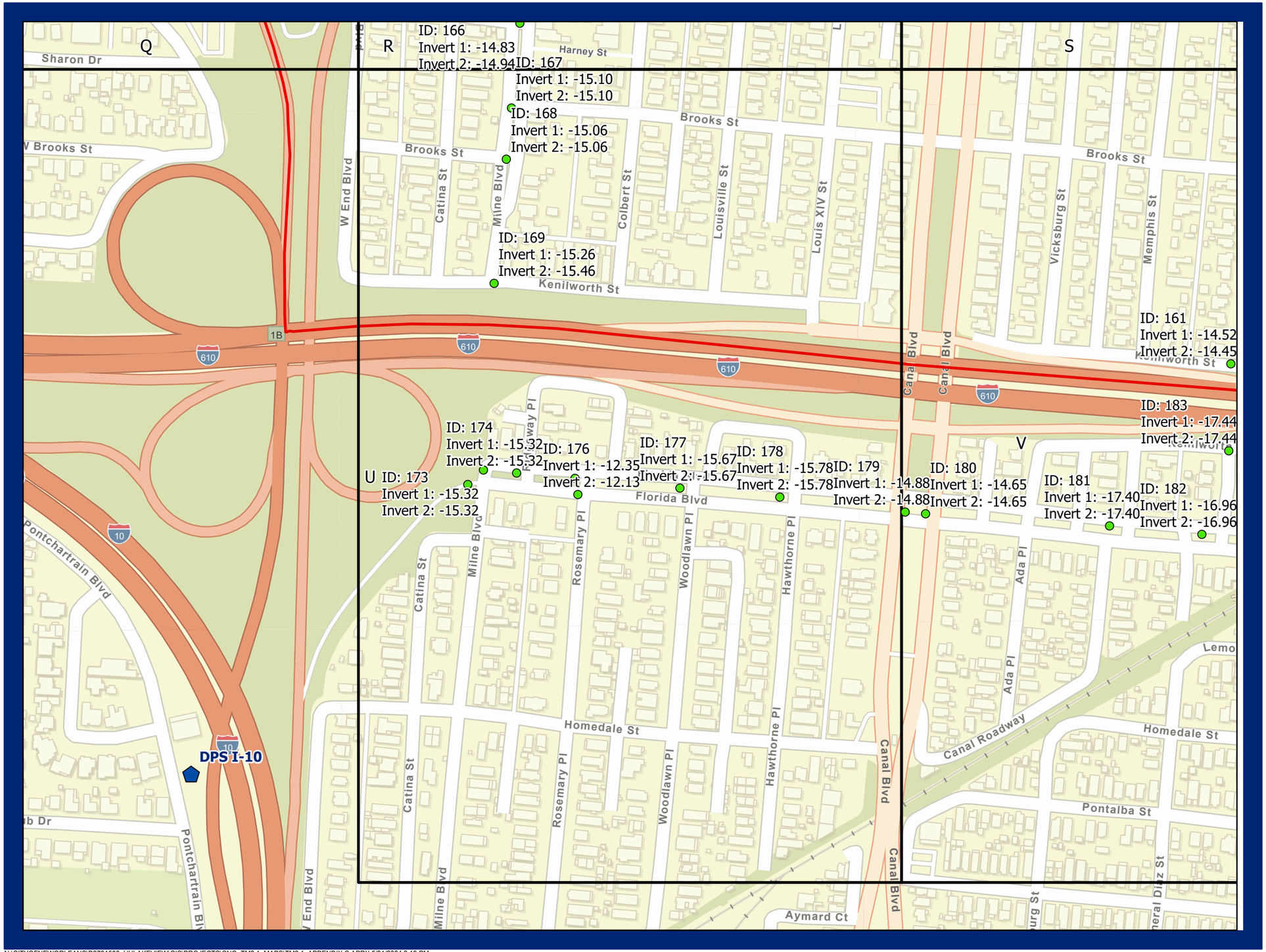

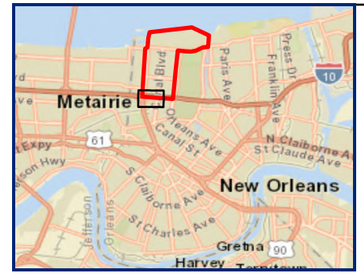

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.U:

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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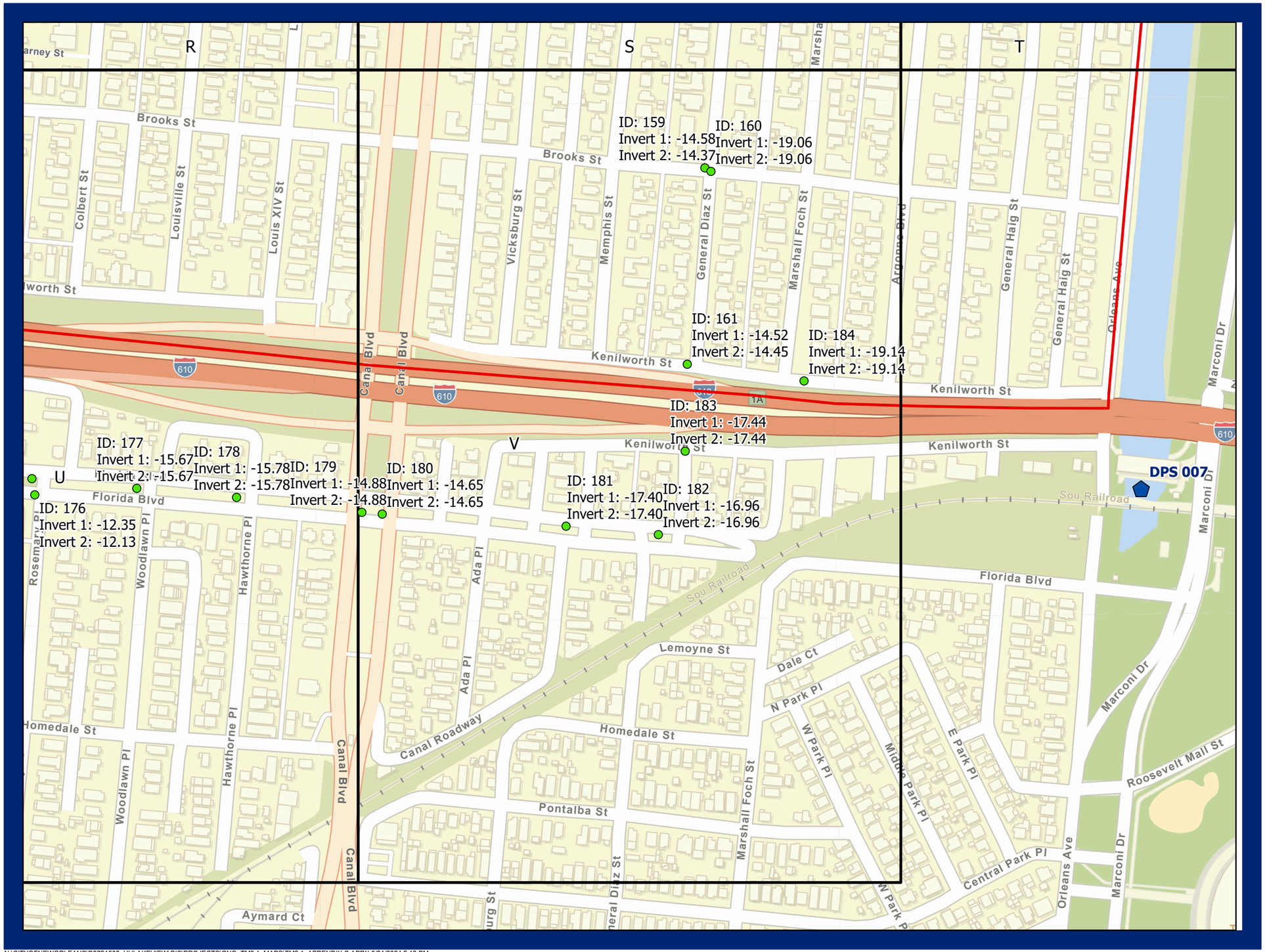

LEGEND

- Lakeview H&H Study Boundary
- Batture Survey
- Drainage Pump Station

0 2.5 5 10 Miles

Appendix C.1.V:

Batture Survey Map Elements

City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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APPENDIX C.2 ENGINEERING SURVEY

ID	X	Y	Z	Drop MH	TOC	Invert 1	Length 1	Width 1	Pipe Direction 1	Type 1	Shape 1	Invert 2	Length 2	Width 2	Pipe Direction 2	Type 2	Shape 2	Notes*
1	556755.1	3676275.6	0.09	dmh	0.09	-8.53		36.0	SW	CONCRETE	CIRCLE							
2	556417.82	3676279.57	-0.91	dmh	-0.91	-8.91		36.0	NE	CONCRETE	CIRCLE	-8.96		36	SW	CONCRETE	CIRCLE	
3	556061.99	3676235.52	-1.38	dmh	-1.38	-9.37		36.0	NE	CONCRETE	CIRCLE	-9.48		42	SW	CONCRETE	CIRCLE	
4	555748.12	3676231.14	-1.88	dmh	-1.88	-10.57		42.0	NE	CONCRETE	CIRCLE	-10.58		42	SE	CONCRETE	CIRCLE	
5	555375.61	3676292.81	-2.06	dmh	-2.06	-11.68		42.0	NW	CONCRETE	CIRCLE	-11.81		42	SW	CONCRETE	CIRCLE	
6	555138.32	3675591.35	-2.21	dmh	-2.21	-11.12	5.5	5.0	NE	CONCRETE	RECT.	-11.12	5.5	5	SW	CONCRETE	RECT.	
7	555003.5	3675282.56	-3.11	dmh	-3.11	-11.49	5.5	5.0	NE	CONCRETE	RECT.	-11.61	5.5	5	SW	CONCRETE	RECT.	
8	554835.24	3674974.34	-2.83	dmh	-2.83	-11.76	5.5	5.0	NE	CONCRETE	RECT.	-11.78	5.5	5	SW	CONCRETE	RECT.	
9	554670.23	3674667.63	-3.32	dmh	-3.32	-12.03	5.5	5.0	NE	CONCRETE	RECT.	-12.18	5.5	5	SW	CONCRETE	RECT.	
10	554545.41	3674377.35	-2.81	dmh	-2.81	-12.32	5.5	5.0	NE	CONCRETE	RECT.	-12.33	5.5	5	SW	CONCRETE	RECT.	
11	554429.48	3673966.93	-3.72	dmh	-3.72	-12.67	5.5	5.0	NE	CONCRETE	RECT.	-12.67	5.5	5	SW	CONCRETE	RECT.	
12	554382.89	3673632.88	-3.15	dmh	-3.15	-12.36	5.5	5.0	NE	CONCRETE	RECT.	-12.47	5.5	5	SW	CONCRETE	RECT.	
13	554376.56	3673300.26	-3.57	dmh	-3.57	-12.81	5.5	5.0	NE	CONCRETE	RECT.	-12.83	5.5	5	SW	CONCRETE	RECT.	
14	554405.25	3672963.36	-3.54	dmh	-3.54	-12.96	5.5	5.0	SE	CONCRETE	RECT.	-13.24	5.5	5	NW	CONCRETE	RECT.	
15	554447.09	3672504.06	-2.14	dmh	-2.14	-13.19	5.5	5.0	SE	CONCRETE	RECT.	-13.16	5.5	5	NW	CONCRETE	RECT.	
16	554469.98	3672203.67	-2.58	dmh	-2.58	-12.72	5.5	5.0	SE	CONCRETE	RECT.	-12.73	5.5	5	NW	CONCRETE	RECT.	
17	554480.56	3672248.03	-2.87	dmh	-2.87	-9.49		36.0	NE	CONCRETE	CIRCLE	-10.62		36	SW	CONCRETE	CIRCLE	
18	554817.73	3672531.46	-2.17	dmh drop inlet	-2.17	-7.68		36.0	NE	CONCRETE	CIRCLE	-7.68		36	SW	CONCRETE	CIRCLE	
19	555203.47	3672855.44	-1.06	dmh drop inlet	-1.06	-7.06		36.0	NE	CONCRETE	CIRCLE	-7.06		36	SW	CONCRETE	CIRCLE	
20	555583.27	3673176.23	0.36	dmh drop inlet	0.36	-6.37		36.0	NE	CONCRETE	CIRCLE	-6.37		36	SW	CONCRETE	CIRCLE	
21	556283.41	3673506.45	1.90	dmh drop inlet	1.90	-0.91	NA	15	NW	CONCRETE	CIRCLE	-0.91	NA	15	SE	CONCRETE	CIRCLE	A
22	556513.27	3673489.61	3.23	dmh	3.23	-5.09		36.0	NE	CONCRETE	CIRCLE	-5.16		36	SE	CONCRETE	CIRCLE	
23	556589.56	3673937.79	3.71	dmh	3.71	-5.21		36.0	SW	CONCRETE	CIRCLE							
24	554810.98	3672163.24	-2.00	dmh	-2	-7.02		24.0	NE	CONCRETE	CIRCLE	-7.11		24	SW	CONCRETE	CIRCLE	
25	555247.94	3672168.1	-1.26	dmh	-1.26	-9.16		48.0	NW	CONCRETE	CIRCLE	-9.16		48	SW	CONCRETE	CIRCLE	
26	555568.43	3672082.97	-0.72	dmh	-0.72	-8.65		48.0	NW	CONCRETE	CIRCLE	-8.79		48	SE	CONCRETE	CIRCLE	
27	555893.21	3671997.04	-0.33	dmh	-0.33	-8.31		48.0	NW	CONCRETE	CIRCLE	-8.38		48	SE	CONCRETE	CIRCLE	
28	556221.43	3671912.73	0.04	dmh	0.04	-7.58		36.0	NW	CONCRETE	CIRCLE	-7.67		36	SE	CONCRETE	CIRCLE	
29	556568.32	3671987.45	0.21	dmh	0.21	-7.34		36.0	NE	CONCRETE	CIRCLE	-7.38		36	SW	CONCRETE	CIRCLE	
30	556995.88	3672301.64	1.39	dmh	1.39	-6.77		36.0	NE	CONCRETE	CIRCLE	-6.77		36	SW	CONCRETE	CIRCLE	
31	557207.24	3672383.22	1.11	dmh	1.11	-6.18		36.0	SW	CONCRETE	CIRCLE							
32	554501.48	3671469.84	-1.16	cb	-1.16	-8.86		18.0	SW	CONCRETE	CIRCLE							
33	554531.4	3671213.74	-3.49	mh	-3.49	-13.53	7.0	10.0	NW	CONCRETE	RECT.	-13.53	7	10	SE	CONCRETE	RECT.	
34	554552.92	3671225.07	-4.02	mh	-4.02	-10.22		24.0	NE	CONCRETE	CIRCLE	-10.22		27	SW	CONCRETE	CIRCLE	
35	554556.14	3671195.14	-4.28	mh	-4.28	-11.13		36.0	NE	CONCRETE	CIRCLE	-11.18		36	SW	CONCRETE	CIRCLE	
36	554802.62	3671217.2	-2.96	mh	-2.96	-10.52		36.0	NE	CONCRETE	CIRCLE	-10.57		36	SW	CONCRETE	CIRCLE	
37	555076.51	3671242.2	-1.31	dmh	-1.31	-8.35		36.0	SW	CONCRETE	CIRCLE							
38	554567.41	3670818.55	-4.02	dmh	-4.02	-14.13	7.0	10.0	SE	CONCRETE	RECT.	-14.57	7	10	NW	CONCRETE	RECT.	
39	554596.36	3670500.8	-4.54	dmh	-4.54	-14.66	7.0	10.0	SE	CONCRETE	RECT.	-14.66	7	10	NW	CONCRETE	RECT.	
40	554623.79	3670200.6	-4.80	dmh	-4.8	-14.85	7.0	10.0	SE	CONCRETE	RECT.	-14.85	7	10	NW	CONCRETE	RECT.	
41	554654.62	3669862.13	-4.52	dmh	-4.52	-15.24	7.0	10.0	SE	CONCRETE	RECT.	-15.27	7	10	NW	CONCRETE	RECT.	
42	554683.29	3669545.69	-5.01	dmh	-5.01	-15.22	7.0	10.0	SE	CONCRETE	RECT.	-15.27	7	10	NW	CONCRETE	RECT.	

APPENDIX C.2 ENGINEERING SURVEY

ID	X	Y	Z	Drop MH	TOC	Invert 1	Length 1	Width 1	Pipe Direction 1	Type 1	Shape 1	Invert 2	Length 2	Width 2	Pipe Direction 2	Type 2	Shape 2	Notes*
43	554712.24	3669233.05	-3.87	dmh	-3.87	-15.77	7.0	10.0	SE	CONCRETE	RECT.	-15.87	7	10	NW	CONCRETE	RECT.	
44	554738.89	3669158.71	-2.33	dmh	-2.33	-16.28	-	7.0	NE	CONCRETE	RECT.	-16.28	-	7	SW	CONCRETE	RECT.	
45	554732.23	3669071.03	-4.76	dmh	-4.76	-14.83		36.0	NW	CONCRETE	CIRCLE	-14.84		48	SE	CONCRETE	CIRCLE	
46	554759.21	3668778.96	-4.82	dmh	-4.82	-14.22		36.0	NW	CONCRETE	CIRCLE	-14.22		36	SE	CONCRETE	CIRCLE	
47	554746.12	3668711.76	-4.52	dmh	-4.52	-16.19	14	ND	NW	CONCRETE	RECT.	-16.19	14	ND	SE	CONCRETE	RECT.	
48	554773.99	3668409.09	-5.05	dmh	-5.05	-16.7	14	ND	NW	CONCRETE	RECT.	-16.7	14	ND	SE	CONCRETE	RECT.	
49	555700.92	3669245.53	1.93	dmh	1.93	-11.77		72.0	NE	CONCRETE	CIRCLE	-11.77		72	SW	CONCRETE	CIRCLE	
50	555956.28	3669269.08	1.10	dmh	1.1	-7.96		36.0	NW	CONCRETE	CIRCLE	-13.02		72	SW	CONCRETE	CIRCLE	
51	555939.65	3669360.31	-1.00	dmh	-1	-7.95		42.0	SE	CONCRETE	CIRCLE	-8.05		42	NW	CONCRETE	CIRCLE	
52	555917.64	3669607.87	-0.25	dmh	-0.25	-		42.0	NE	CONCRETE	CIRCLE	-7.8		42	NW	CONCRETE	CIRCLE	
53	555290.3	3669901.03	-1.51	dmh	-1.51	-10.27		36.0	SW	CONCRETE	CIRCLE							
54	555116.63	3669685.77	-2.50	dmh	-2.5	-		36.0	NE	CONCRETE	CIRCLE	-12.36		42	SW	CONCRETE	CIRCLE	
55	554938.35	3669479.81	-3.51	dmh	-3.51	-12.42		42.0	NE	CONCRETE	CIRCLE	-		42	SW	CONCRETE	CIRCLE	
56	555956.12	3669183.44	-0.55	dmh	-0.55	-7.85		36.0	NW	CONCRETE	CIRCLE	-7.85		36	SE	CONCRETE	CIRCLE	
57	555983.19	3668913.24	0.06	dmh	0.06	-7.2		36.0	NE	CONCRETE	CIRCLE	-7.4		36	SE	CONCRETE	CIRCLE	
58	555369.56	3668107.84	-1.27	dmh	-1.27	-6.89		18.0	NW	CONCRETE	CIRCLE	-6.89		18	SE	CONCRETE	CIRCLE	
59	555349.2	3668405.78	-1.57	dmh	-1.57	-8.06		18.0	SW	CONCRETE	CIRCLE	-8.06		21	NE	CONCRETE	CIRCLE	
60	555388.03	3668511.19	-0.79	dmh	-0.79	ND	NA	42	SW	CONCRETE	CIRCLE	ND	NA	42	SE	CONCRETE	CIRCLE	B
61	555187.77	3668671.59	-2.03	dmh	-2.03	-12.42		42.0	NW	CONCRETE	CIRCLE	-12.42		42	SE	CONCRETE	CIRCLE	
62	555172.62	3668684.61	-2.12	dmh	-2.12	-12.44		42.0	NW	CONCRETE	CIRCLE	-12.6		42	SE	CONCRETE	CIRCLE	
63	554982.01	3668846.98	-2.49	dmh	-2.49	-12.69		42.0	NW	CONCRETE	CIRCLE	-12.79		42	SE	CONCRETE	CIRCLE	
64	554583.2	3669139.74	-3.34	dmh	-3.34	-15.69	7.5	-	E	CONCRETE	RECT.	-15.69	-	7.5	S	CONCRETE	RECT.	
65	553936.12	3669080.39	-4.64	dmh	-4.64	-15.69	7.5	-	E	CONCRETE	RECT.	-15.69	-	7.5	S	CONCRETE	RECT.	
66	553278.61	3669020.12	-4.32	dmh	-4.32	-15.92	7.5	ND	E	CONCRETE	RECT.	-15.92	ND	7.5	S	CONCRETE	RECT.	
67	552625.25	3668960.24	-4.46	dmh	-4.46	-15.91	7.5	ND	E	CONCRETE	RECT.	-15.91	ND	7.5	S	CONCRETE	RECT.	
68	552658.43	3668891.25	-6.60	dmh	-6.6	-15.45	NA	18	E	CONCRETE	CIRCLE	-15.17	NA	18	W	CONCRETE	CIRCLE	
69	552717.66	3668562.71	-7.91	dmh	-7.91	-15.56	NA	48	E	CONCRETE	CIRCLE	-15.56	NA	48	W	CONCRETE	CIRCLE	
70	552745.94	3668248.05	-8.09	dmh	-8.09	-15.79	NA	48	E	CONCRETE	CIRCLE	-15.79	NA	48	W	CONCRETE	CIRCLE	
71	552644.27	3669047.95	-6.62	dmh	-6.62	-14.57	NA	18	E	CONCRETE	CIRCLE	-14.72	NA	18	W	CONCRETE	CIRCLE	
72	552627.76	3669348.22	-7.72	dmh	-7.72	-16.07	NA	48	E	CONCRETE	CIRCLE	-16.07	NA	48	W	CONCRETE	CIRCLE	
73	552598.47	3669670.27	-7.48	dmh	-7.48	-16.19	NA	48	E	CONCRETE	CIRCLE	-16.19	NA	48	W	CONCRETE	CIRCLE	
74	552570.15	3669985.22	-7.52	dmh	-7.52	-15.42	NA	48	E	CONCRETE	CIRCLE	-15.42	NA	48	W	CONCRETE	CIRCLE	
75	552541.42	3670302.03	-7.12	dmh	-7.12	-15.32	NA	48	E	CONCRETE	CIRCLE	-15.32	NA	48	W	CONCRETE	CIRCLE	
76	552516	3670616.2	-8.21	dmh	-8.21	-15.16	NA	48	E	CONCRETE	CIRCLE	-15.16	NA	48	W	CONCRETE	CIRCLE	
77	552513	3670647	-7.97	dmh	-7.97	-14.27	NA	30	E	CONCRETE	CIRCLE	-15.57	NA	48	W	CONCRETE	CIRCLE	
78	552508.26	3670675.29	-8.31	dmh	-8.31	-14.06	NA	24	E	CONCRETE	CIRCLE	-16.21	NA	30	W	CONCRETE	CIRCLE	
79	553167.03	3670705.81	-7.83	dmh	-7.83	-15.05	NA	30	N	CONCRETE	CIRCLE	-15.38	NA	36	S	CONCRETE	CIRCLE	
80	553845.1	3670765.45	-7.36	dmh	-7.36	-13.83	NA	24	N	CONCRETE	CIRCLE	-13.91	NA	30	S	CONCRETE	CIRCLE	
81	556236.61	3668936.52	0.24	dmh	0.24	-7.21		36.0	N	CONCRETE	CIRCLE	-7.21		42	S	CONCRETE	CIRCLE	
82	556078.09	3669624.54	-0.06	dmh	-0.06	-5.62	NA	15	N	CONCRETE	CIRCLE	-6.01	NA	15	S	CONCRETE	CIRCLE	A
83	556171.44	3669651.47	0.67	dmh	0.67	-7.78		36.0	N	CONCRETE	CIRCLE	-7.78		36	S	CONCRETE	CIRCLE	
84	556439.59	3669677.68	0.69	dmh	0.69	-7.93		24.0	N	CONCRETE	CIRCLE	-7.81		36	S	CONCRETE	CIRCLE	

APPENDIX C.2 ENGINEERING SURVEY

ID	X	Y	Z	Drop MH	TOC	Invert 1	Length 1	Width 1	Pipe Direction 1	Type 1	Shape 1	Invert 2	Length 2	Width 2	Pipe Direction 2	Type 2	Shape 2	Notes*
85	556730.45	3669683.64	0.34	dmh	0.34	-7.01		30.0	E	CONCRETE	CIRCLE	-7.01		36	W	CONCRETE	CIRCLE	
86	556737.03	3669408.77	-0.03	dmh	-0.03	-7.53	NA	24	E	CONCRETE	CIRCLE	-7.44	NA	24	W	CONCRETE	CIRCLE	A
87	556763.93	3669347.65	1.87	dmh	1.87	-		60.0	S	CONCRETE	CIRCLE	-7.43		36	E	CONCRETE	CIRCLE	
88	555841.36	3667759.59	-0.11	dmh	-0.11	-8.71	NA	30	NW	CONCRETE	CIRCLE	-8.71	NA	36	SE	CONCRETE	CIRCLE	
89	555468.84	3667847.1	-1.55	dmh	-1.55	-6.20	NA	18	NW	CONCRETE	CIRCLE	ND	NA	ND	ND	CONCRETE	ND	
90	555392.1	3667935.46	-1.51	dmh	-1.51	-6.24	NA	18	NW	CONCRETE	CIRCLE	-6.26	NA	18	SE	CONCRETE	CIRCLE	
91	552778.37	3667889.1	-7.46	dmh	-7.46	-14.81	NA	54	NE	CONCRETE	CIRCLE	-14.88	NA	54	NW	CONCRETE	CIRCLE	
92	553451.53	3667613.7	-6.99	dmh	-6.99	-14.75	NA	36	N	CONCRETE	CIRCLE	-14.75	NA	36	S	CONCRETE	CIRCLE	
93	554031.85	3667670.06	-7.17	dmh	-7.17	-13.87	NA	18	E	CONCRETE	CIRCLE	-13.92	NA	36	S	CONCRETE	CIRCLE	
94	554622.43	3666858.95	-7.65	dmh	-7.65	-		24.0	NE	CONCRETE	CIRCLE	-16.45		36	SW	CONCRETE	CIRCLE	
95	554196.36	3666834.42	-7.51	dmh	-7.51	-16.06		36.0	NE	CONCRETE	CIRCLE	-		36	SW	CONCRETE	CIRCLE	
96	553903.7	3666819.76	-7.54	dmh	-7.54	-15.64		36.0	NE	CONCRETE	CIRCLE	-		36	SW	CONCRETE	CIRCLE	
97	553661.92	3666805.95	-7.12	dmh	-7.12	-15.42		36.0	NE	CONCRETE	CIRCLE	-		36	SW	CONCRETE	CIRCLE	
98	553145.99	3666777.44	-7.36	dmh	-7.36	-16.21		36.0	NE	CONCRETE	CIRCLE	-		42	SW	CONCRETE	CIRCLE	
99	552464.32	3666735.74	-6.56	dmh	-6.56	-		36.0	NE	CONCRETE	CIRCLE	-13.46		36	SW	CONCRETE	CIRCLE	
100	552247.07	3666727.48	-5.60	dmh	-5.6	-14.55		36.0	NE	CONCRETE	CIRCLE	-14.05		76	SW	CONCRETE	CIRCLE	
101	554851.63	3667755.13	-4.65	dmh	-4.65	-13.47		30.0	E	CONCRETE	CIRCLE	-13.57		30	W	CONCRETE	CIRCLE	
102	554834.69	3667738.8	-4.28	dmh	-4.28	-16.33	14	ND	NW	CONCRETE	RECT.	-16.33	14	ND	SE	CONCRETE	RECT.	
103	554861.9	3667643.65	-5.12	dmh	-5.12	-14.07		30.0	E	CONCRETE	CIRCLE	-13.97		50	W	CONCRETE	CIRCLE	
104	554929.77	3666903.7	-5.17	dmh	-5.17	-10.67	NA	30	N	CONCRETE	CIRCLE	ND	ND	ND	ND	CONCRETE	ND	A
105	554949.36	3666840.41	-4.48	dmh	-4.48	-9.43		18.0	NE	CONCRETE	CIRCLE	-10.38		21	SE	CONCRETE	CIRCLE	
106	554869	3666641.19	-2.56	dmh	-2.56	-7.01	NA	15	NW	CONCRETE	CIRCLE	-7.01	NA	18	SE	CONCRETE	CIRCLE	A
107	554976.7	3666525.88	-0.85	dmh	-0.85	-7.80	NA	18	E	CONCRETE	CIRCLE	-7.42	NA	18	S	CONCRETE	CIRCLE	C
108	554658.72	3666613.16	-2.82	vault	-2.82	ND	ND	ND	ND	CONCRETE	ND	ND	ND	ND	ND	CONCRETE	ND	B
109	554639.55	3666477.33	-4.72	dmh	-4.72	-14.02	NA	18	SW	CONCRETE	CIRCLE	-9.52	NA	18	NE	CONCRETE	CIRCLE	C
110	554616.45	3666136.2	-4.94	dmh	-4.94	-17.48	10	ND	E	CONCRETE	RECT.	-17.48	10	ND	W	CONCRETE	RECT.	C
111	554644.9	3665605.47	-4.44	dmh	-4.44	-17.55	10	ND	E	CONCRETE	RECT.	-17.55	10	ND	W	CONCRETE	RECT.	C
112	552664.05	3665480.62	-8.81	dmh	-8.81	-14.96	NA	30	E	CONCRETE	CIRCLE	-15.11	NA	30	W	CONCRETE	CIRCLE	C
113	552310.43	3665409.88	-6.68	dmh	-6.68	-16.33	10	ND	N	CONCRETE	RECT.	-16.33	10	ND	S	CONCRETE	RECT.	C
114	552344.25	3665367.56	-8.61	dmh	-8.61	-14.91	NA	24	E	CONCRETE	CIRCLE	ND	ND	ND	ND	CONCRETE	ND	C
115	553596.68	3665479.59	-7.55	dmh	-7.55	ND	ND	ND	ND	CONCRETE	ND	ND	ND	ND	ND	CONCRETE	ND	B
116	552967.72	3665445.75	-7.52	dmh	-7.52	ND	ND	ND	ND	CONCRETE	ND	ND	ND	ND	ND	CONCRETE	ND	B
117	550577.94	3665315.42	-6.93	dmh	-6.93	-15.78	10	ND	N	CONCRETE	RECT.	-15.78	10	ND	S	CONCRETE	RECT.	C
118	549372.61	3665249.89	-6.31	dmh	-6.31	-15.21	10	ND	N	CONCRETE	RECT.	-15.21	10	ND	S	CONCRETE	RECT.	C
119	548774.04	3665217.26	-5.13	dmh	-5.13	-14.88	10	ND	N	CONCRETE	RECT.	-14.88	10	ND	S	CONCRETE	RECT.	C
120	552046.98	3666715.43	-7.01	dmh	-7.01	-13.82		36.0	NE	CONCRETE	CIRCLE	-		30	SW	CONCRETE	CIRCLE	
121	551471.14	3667418.29	-6.29	dmh	-6.29	-14.77		30.0	NE	CONCRETE	CIRCLE	-15.04		36	SW	CONCRETE	CIRCLE	
122	550158.2	3667288.4	-6.56	dmh	-6.56	-	40.0	36.0	NE	CONCRETE	CIRCLE	-16.26	40	36	SW	CONCRETE	CIRCLE	
123	549992.8	3666603.91	-7.26	dmh	-7.26	-13.91	40.0	36.0	NE	CONCRETE	CIRCLE	-14.11	40	36	SW	CONCRETE	CIRCLE	
124	549807.52	3666594.62	-7.28	dmh	-7.28	-14.28	40.0	36.0	NE	CONCRETE	CIRCLE	-14.43	40	36	SW	CONCRETE	CIRCLE	
125	549484.77	3666577.16	-4.98	dmh	-4.98	-14.96		36.0	NE	CONCRETE	CIRCLE	-15.08		36	SE	CONCRETE	CIRCLE	
126	549411.37	3667213.31	-4.16	dmh	-4.16	-16.18		36.0	NE	CONCRETE	CIRCLE	-		36	SE	CONCRETE	CIRCLE	

APPENDIX C.2 ENGINEERING SURVEY

ID	X	Y	Z	Drop MH	TOC	Invert 1	Length 1	Width 1	Pipe Direction 1	Type 1	Shape 1	Invert 2	Length 2	Width 2	Pipe Direction 2	Type 2	Shape 2	Notes*
127	549467.36	3667222.32	-5.27	dmh	-5.27	-16.22		36.0	NE	CONCRETE	CIRCLE	-		36	SE	CONCRETE	CIRCLE	
128	549375.22	3667603.98	-5.84	dmh	-5.84	-		36.0	SE	CONCRETE	CIRCLE	-16.89		36	NW	CONCRETE	CIRCLE	
129	549344.98	3667938.7	-5.93	dmh	-5.93	-		36.0	NE	CONCRETE	CIRCLE	-16.98		36	NW	CONCRETE	CIRCLE	
130	549314.67	3668272.74	-5.71	dmh	-5.71	-		36.0	NE	CONCRETE	CIRCLE	-17.12		36	NW	CONCRETE	CIRCLE	
131	549286.14	3668581.52	-5.24	dmh	-5.24	-		36.0	NE	CONCRETE	CIRCLE	-17.29		36	SW	CONCRETE	CIRCLE	
132	549242.21	3669057.21	-4.92	dmh	-4.92	-		42.0	SE	CONCRETE	CIRCLE	-16.47		42	NW	CONCRETE	CIRCLE	
133	549212.91	3669383.76	-5.32	dmh	-5.32	ND	NA	42	SE	CONCRETE	CIRCLE	-16.77	NA	42	NW	CONCRETE	CIRCLE	
134	551968.37	3668899.98	-3.75	dmh	-3.75	-16.36	7.5	ND	NE	CONCRETE	RECT.	-16.36	7.5	ND	SW	CONCRETE	RECT.	
135	551311.14	3668840.27	-3.90	dmh	-3.9	-16.71	7.5	ND	NE	CONCRETE	RECT.	-16.71	7.5	ND	SW	CONCRETE	RECT.	
136	550629.3	3668786.26	-4.31	dmh	-4.31	-17.16	7.5	ND	NE	CONCRETE	RECT.	-17.16	7.5	ND	SW	CONCRETE	RECT.	
137	550079.25	3668735.86	-3.74	dmh	-3.74	-17.25	7.5	ND	NE	CONCRETE	RECT.	-17.25	7.5	ND	SW	CONCRETE	RECT.	
138	549343.58	3668668.63	-3.23	dmh	-3.23	-16.63	7.5	ND	NE	CONCRETE	RECT.	-16.63	7.5	ND	SW	CONCRETE	RECT.	
139	549026.77	3668639.48	-3.47	dmh	-3.47	-17.38	9	ND	NE	CONCRETE	RECT.	-17.38	9	ND	SW	CONCRETE	RECT.	
140	549184.148	3669695.484	-4.87	DMH	-4.869	ND	NA	42	SE	CONCRETE	CIRCLE	-16.02	NA	42	NW	CONCRETE	CIRCLE	
141	549154.148	3670017.796	-5.06	DMH	-5.056	ND	NA	42	SE	CONCRETE	CIRCLE	-15.80	NA	42	NW	CONCRETE	CIRCLE	
142	549125.813	3670328.927	-4.25	DMH	-4.246	-15.40	NA	42	NE	CONCRETE	CIRCLE	-15.62	NA	42	NW	CONCRETE	CIRCLE	
143	549178.006	3670341.644	-5.95	DMH	-5.952	ND	NA	42	NE	CONCRETE	CIRCLE	-15.13	NA	42	SW	CONCRETE	CIRCLE	
144	549877.275	3670405.447	-5.95	DMH	-5.948	ND	NA	42	NE	CONCRETE	CIRCLE	-14.20	NA	42	SW	CONCRETE	CIRCLE	
145	550535.232	3670466.095	-6.09	DMH	-6.09	ND	NA	36	NE	CONCRETE	CIRCLE	-13.86	NA	42	SW	CONCRETE	CIRCLE	
146	551185.402	3670521.784	-6.03	DMH	-6.025	-12.97	NA	36	NE	CONCRETE	CIRCLE	ND	NA	36	SW	CONCRETE	CIRCLE	
147	551851.239	3670584.214	-6.40	DMH	-6.4	-12.70	NA	24	SE	CONCRETE	CIRCLE	-12.27	NA	36	SW	CONCRETE	CIRCLE	
148	548662.426	3668606.356	-3.58	DMH	-3.578	-17.58	9	ND	NE	CONCRETE	RECT.	-17.58	9	ND	SW	CONCRETE	RECT.	
149	547990.567	3668544.804	-3.62	DMH	-3.615	-17.89	9	ND	NE	CONCRETE	RECT.	-17.89	9	ND	SW	CONCRETE	RECT.	
150	547292.885	3668408.559	-5.31	DMH	-5.312	-16.41	NA	42	SE	CONCRETE	CIRCLE	ND	ND	ND	ND	CONCRETE	ND	
151	547320.064	3668489.842	-3.67	DMH	-3.674	-18.08	9	ND	NE	CONCRETE	RECT.	-18.08	9	ND	SW	CONCRETE	RECT.	
152	547292.123	3668558.326	-5.64	DMH	-5.642	-10.65	NA	12	NE	CONCRETE	CIRCLE	-10.79	NA	15	SE	CONCRETE	CIRCLE	A
153	547265.89	3668846.012	-6.85	DMH	-6.847	-14.41	NA	12	NW	CONCRETE	CIRCLE	-12.75	NA	12	SE	CONCRETE	CIRCLE	A
154	547236.521	3669168.936	-5.83	DMH	-5.826	-12.73	NA	15	NE	CONCRETE	CIRCLE	-12.67	NA	15	SW	CONCRETE	CIRCLE	A
155	547189.372	3669164.844	-5.95	DMH	-5.949	-10.36	NA	18	NE	CONCRETE	CIRCLE	-9.96	NA	15	NW	CONCRETE	CIRCLE	A
156	547158.173	3669523.202	-5.60	DMH	-5.6	-12.75	NA	21	NE	CONCRETE	CIRCLE	-12.93	NA	24	NW	CONCRETE	CIRCLE	A
157	547181.409	3669527.703	-5.64	DMH	-5.636	ND	NA	42	NE	CONCRETE	CIRCLE	-14.61	NA	42	SW	CONCRETE	CIRCLE	
158	547121.445	3669499.359	-5.28	DMH	-5.277	-18.70	9	ND	NE	CONCRETE	RECT.	-18.70	9	ND	SW	CONCRETE	RECT.	
159	546537.348	3669420.313	-5.65	DMH	-5.646	-14.58	NA	24	NE	CONCRETE	CIRCLE	-14.37	NA	18	NW	CONCRETE	CIRCLE	
160	546525.562	3669440.739	-5.04	DMH	-5.044	-19.06	9	ND	NE	CONCRETE	RECT.	-19.06	9	ND	SW	CONCRETE	RECT.	
161	545879.487	3669361.4	-5.40	DMH	-5.402	-14.52	NA	18	NE	CONCRETE	CIRCLE	-14.45	NA	18	NW	CONCRETE	CIRCLE	
162	548071.991	3666488.802	-6.01	DMH	-6.011	-13.21	NA	36	S	CONCRETE	CIRCLE	ND	ND	ND	ND	CONCRETE	ND	
163	547086.264	3666434.207	-5.49	DMH	-5.493	ND	NA	36	NE	CONCRETE	CIRCLE	-11.19	NA	42	SW	CONCRETE	CIRCLE	
164	547058.227	3666757.485	-5.35	DMH	-5.353	-14.07	NA	42	NE	CONCRETE	CIRCLE	-13.58	NA	42	NW	CONCRETE	CIRCLE	
165	547039.906	3666986.437	-5.21	DMH	-5.207	-14.53		42.0	NE	CONCRETE	CIRCLE	-		42	SW	CONCRETE	CIRCLE	
166	547019.668	3666982.019	-5.23	DMH	-5.225	-14.83	NA	42	NE	CONCRETE	CIRCLE	-14.94	NA	42	SW	CONCRETE	CIRCLE	
167	546735.878	3666953.893	-4.77	DMH	-4.77	-15.10	NA	42	NE	CONCRETE	CIRCLE	-15.10	NA	42	SW	CONCRETE	CIRCLE	
168	546564.501	3666936.704	-5.30	DMH	-5.299	-15.06	NA	42	NE	CONCRETE	CIRCLE	-15.06	NA	42	SW	CONCRETE	CIRCLE	

APPENDIX C.2 ENGINEERING SURVEY

ID	X	Y	Z	Drop MH	TOC	Invert 1	Length 1	Width 1	Pipe Direction 1	Type 1	Shape 1	Invert 2	Length 2	Width 2	Pipe Direction 2	Type 2	Shape 2	Notes*
169	546148.879	3666895.751	-5.84	DMH	-5.839	-15.26	NA	42	NE	CONCRETE	CIRCLE	-15.46	NA	42	SW	CONCRETE	CIRCLE	
170	547400.387	3667019.43	-6.22	DMH	-6.221	-14.12	NA	42	NE	CONCRETE	CIRCLE	-14.53	NA	42	SW	CONCRETE	CIRCLE	
171	547555.649	3667034.472	-5.92	DMH	-5.915	-13.92	NA	24	NE	CONCRETE	CIRCLE	-14.51	NA	42	SW	CONCRETE	CIRCLE	
172	545475.474	3666807.733	-3.62	DMH	-3.62	-11.07	NA	24	NW	CONCRETE	CIRCLE	-12.65	NA	24	SE	CONCRETE	CIRCLE	C
173	545523.895	3666860.088	-3.60	DMH	-3.597	-15.32	7	ND	NW	CONCRETE	RECT.	-15.32	7	ND	SE	CONCRETE	RECT.	
174	545514.015	3666971.095	-2.97	DMH	-2.973	-15.32	7	ND	NW	CONCRETE	RECT.	-15.32	7	ND	SE	CONCRETE	RECT.	C
175	545496.065	3667166.401	-2.57	DMH	-2.569	-15.43	7	6	NE	CONCRETE	RECT.	-15.43	7	6	NW	CONCRETE	RECT.	C
176	545441.959	3667176.065	-4.35	DMH	-4.352	-12.35	ND	18	NW	CONCRETE	RECT.	-12.13	ND	18	SE	CONCRETE	RECT.	C
177	545463.495	3667517.627	-2.46	DMH	-2.46	-15.67	7	ND	NW	CONCRETE	RECT.	-15.67	7	ND	SE	CONCRETE	RECT.	C
178	545433.291	3667851.899	-2.40	DMH	-2.402	-15.78	7	ND	NW	CONCRETE	RECT.	-15.78	7	ND	SE	CONCRETE	RECT.	C
179	545383.226	3668271.421	-0.88	DMH	-0.881	-14.88	NA	48	NW	CONCRETE	CIRCLE	-14.88	NA	48	SE	CONCRETE	CIRCLE	C
180	545377.4	3668339.741	-1.47	DMH	-1.465	-14.65	NA	48	NE	CONCRETE	CIRCLE	-14.65	NA	48	SW	CONCRETE	CIRCLE	C
181	545336.853	3668955.445	-3.91	DMH	-3.913	-17.40	8	ND	NE	CONCRETE	RECT.	-17.40	8	ND	SW	CONCRETE	RECT.	C
182	545308.585	3669264.496	-3.31	DMH	-3.312	-16.96	8	ND	NE	CONCRETE	RECT.	-16.96	8	ND	NW	CONCRETE	RECT.	C
183	545588.211	3669354.456	-5.30	DMH	-5.297	-17.44	8	ND	NE	CONCRETE	RECT.	-17.44	8	ND	SW	CONCRETE	RECT.	C
184	545823.449	3669752.504	-5.36	DMH	-5.364	-19.14	11	ND	W	CONCRETE	RECT.	-19.14	11	ND	E	CONCRETE	RECT.	
185	547155.798	3669806.221	-5.84	DMH	-5.842	-13.86	NA	42	W	CONCRETE	CIRCLE	-13.86	NA	42	E	CONCRETE	CIRCLE	
186	547123.439	3670128.303	-5.87	DMH	-5.868	-13.12	NA	42	W	CONCRETE	CIRCLE	-13.12	NA	42	E	CONCRETE	CIRCLE	
187	547139.966	3670143.443	-5.81	DMH	-5.805	-13.06	ND	ND	S	CONCRETE	RECT.	ND	NA	36	N	CONCRETE	CIRCLE	
188	547791.072	3670213.348	-6.12	DMH	-6.116	-13.82	NA	36	S	CONCRETE	CIRCLE	-13.22	NA	36	N	CONCRETE	CIRCLE	
189	548446.259	3670273.037	-5.62	DMH	-5.623	-12.67	NA	36	S	CONCRETE	CIRCLE	ND	ND	ND	ND	CONCRETE	ND	

***KEY:** A – only minor system checked by Batture, updated within the model
B – no data available (manhole unable to open)
C – outside Lakeview Area and/or not updated within the model
NA – Not Applicable
ND – No Data

APPENDIX C.3 INVERT ELEVATION COMPARISON

Node Name	Updated Model Elevation	Existing Conditions Model Elevation	Difference
DPS07_19038_CDM	-15.32	-14	-1.32
DPS07_28865_CDM	-18.7	-17.95	-0.75
DPS07_28867_CDM	-19.06	-18.2	-0.86
DPS07_28879_CDM	-15.91	-15.9	-0.01
DPS07_28882_CDM	-16.36	-16.01	-0.35
DPS07_28887_CDM	-16.71	-16.15	-0.56
DPS07_28895_CDM	-17.25	-16.4	-0.85
DPS07_28897_CDM	-16.63	-16.6	-0.03
DPS07_28899_CDM	-17.38	-16.7	-0.68
DPS07_28902_CDM	-17.58	-17	-0.58
DPS07_28905_CDM	-17.89	-17.2	-0.69
DPS07_28906_CDM	-18.08	-17.51	-0.57
DPS07_29065_CDM	-14.51	-13.25	-1.26
DPS07_29067_CDM	-14.53	-13.3	-1.23
DPS07_29088_CDM	-16.41	-16.49	0.08
DPS07_29176_CDM	-13.82	-16.9	3.08
DPS07_29203_CDM	-13.06	-17.1	4.04
DPS07_29205_CDM	-13.12	-17.2	4.08
DPS07_29206_CDM	-13.86	-17.5	3.64
DPS07_29207_CDM	-14.61	-17.9	3.29
DPS07_29220_CDM	-14.58	-14.63	0.05
DPS07_29255_CDM	-19.14	-18.45	-0.69
DPS07_29259_CDM	-14.52	-18.09	3.57
DPS07_29298_CDM	-14.07	-13.39	-0.68
DPS07_29301_CDM	-14.94	-13.5	-1.44
DPS07_29302_CDM	-15.1	-13.6	-1.5
DPS07_29310_CDM	-15.06	-13.7	-1.36
DPS07_29386_CDM	-11.19	-13.3	2.11
DPS07_29387_CDM	-14.53	-13.45	-1.08
DPS07_29459_CDM	-12.67	-16.7	4.03
DPS07_29476_CDM	-15.8	-15.1	-0.7
DPS07_29479_CDM	-16.02	-15.25	-0.77
DPS07_29506_CDM	-15.62	-13.93	-1.69
DPS07_29507_CDM	-15.13	-13.85	-1.28
DPS07_29554_CDM	-16.77	-15.45	-1.32
DPS07_29573_CDM	-17.29	-16.55	-0.74
DPS07_29575_CDM	-17.12	-16.25	-0.87
DPS07_29576_CDM	-16.47	-15.65	-0.82
DPS07_29599_CDM	-16.98	-16.05	-0.93
DPS07_29607_CDM	-16.89	-15.9	-0.99
DPS07_29656_CDM	-16.18	-15.8	-0.38
DPS07_29658_CDM	-16.22	-15.75	-0.47

APPENDIX C.3 INVERT ELEVATION COMPARISON

Node Name	Updated Model Elevation	Existing Conditions Model Elevation	Difference
DPS07_30095_CDM	-14.43	-14.3	-0.13
DPS07_30096_CDM	-15.08	-14.81	-0.27
DPS07_30104_CDM	-14.11	-14	-0.11
DPS07_30114_CDM	-16.26	-15.5	-0.76
DPS07_30135_CDM	-15.04	-14.95	-0.09
DPS07_30192_CDM	-13.92	-13.2	-0.72
DPS07_30195_CDM	-14.75	-13.5	-1.25
DPS07_30197_CDM	-14.88	-14.15	-0.73
DPS07_30326_CDM	-15.79	-14.35	-1.44
DPS07_30327_CDM	-15.56	-14.85	-0.71
DPS07_30346_CDM	-15.45	-9.97	-5.48
DPS07_30522_CDM	-15.38	-14.55	-0.83
DPS07_30529_CDM	-15.16	-14.56	-0.6
DPS07_30532_CDM	-15.42	-15.7	0.28
DPS07_30536_CDM	-16.19	-15.76	-0.43
DPS07_30541_CDM	-16.07	-15.82	-0.25
DPS07_30556_CDM	-15.32	-14.63	-0.69
DPS07_30560_CDM	-13.91	-14.18	0.27
DPS07_30561_CDM	-15.57	-14.55	-1.02
DPS07_30566_CDM	-16.21	-14.48	-1.73
DPS07_30570_CDM	-14.72	-10.81	-3.91
DPS07_30657_CDM	-12.97	-13.02	0.05
DPS07_30658_CDM	-13.86	-13.4	-0.46
DPS07_30682_CDM	-12.8	-12.2	-0.6
DPS07_30758_CDM	-14.2	-13.65	-0.55
DPS07_31780_CDM	-14.55	-13.05	-1.5
DPS07_31784_CDM	-13.46	-13.48	0.02
DPS07_31787_CDM	-16.21	-13.76	-2.45
DPS07_31791_CDM	-15.42	-14.02	-1.4
DPS07_31793_CDM	-15.64	-14.45	-1.19
DPS07_31794_CDM	-16.06	-15.22	-0.84
DPS07_31798_CDM	-16.45	-16.8	0.35
DPS07_31804_CDM	-13.82	-12.75	-1.07
DPS12_28871_CDM	-15.69	-15	-0.69
DPS12_28874_CDM	-15.92	-15.18	-0.74
DPS12_28924_CDM	-15.69	-14.92	-0.77
DPS12_28930_CDM	-16.28	-14.9	-1.38
DPS12_29397_CDM	-11.12	-10.75	-0.37
DPS12_29402_CDM	-11.61	-10.8	-0.81
DPS12_29407_CDM	-11.78	-10.85	-0.93
DPS12_29414_CDM	-12.18	-10.9	-1.28
DPS12_30291_CDM	-16.7	-15.4	-1.3

APPENDIX C.3 INVERT ELEVATION COMPARISON

Node Name	Updated Model Elevation	Existing Conditions Model Elevation	Difference
DPS12_30480_CDM	-14.85	-14	-0.85
DPS12_30497_CDM	-15.27	-14.25	-1.02
DPS12_30732_CDM	-14.66	-13.6	-1.06
DPS12_30738_CDM	-14.57	-13.2	-1.37
DPS12_30766_CDM	-13.53	-12.8	-0.73
DPS12_31024_CDM	-7.43	-7.16	-0.27
DPS12_31027_CDM	-13.02	-8.7	-4.32
DPS12_31037_CDM	-7.85	-8.6	0.75
DPS12_31041_CDM	-8.05	-7.96	-0.09
DPS12_31047_CDM	-7.01	-6.61	-0.4
DPS12_31170_CDM	-8.71	-6.89	-1.82
DPS12_31207_CDM	-7.21	-8	0.79
DPS12_31222_CDM	-7.4	-8.28	0.88
DPS12_31266_CDM	-12.42	-12.46	0.04
DPS12_31267_CDM	-12.51	-12.51	0
DPS12_31268_CDM	-12.79	-13.15	0.36
DPS12_31270_CDM	-12.42	-11.68	-0.74
DPS12_31271_CDM	-12.36	-9.5	-2.86
DPS12_31281_CDM	-8.06	-7.81	-0.25
DPS12_31323_CDM	-14.07	-10.51	-3.56
DPS12_31326_CDM	-13.57	-11.08	-2.49
DPS12_31333_CDM	-10.38	-10.54	0.16
DPS12_31337_CDM	-14.22	-13.215	-1.005
DPS12_31338_CDM	-14.84	-13.79	-1.05
DPS12_31375_CDM	-7.93	-7.42	-0.51
DPS12_31381_CDM	-7.78	-7.51	-0.27
DPS12_31383_CDM	-7.8	-7.73	-0.07
DPS12_31464_CDM	-10.27	-8.82	-1.45
DPS12_31478_CDM	-8.35	-8.31	-0.04
DPS12_31481_CDM	-10.57	-10.5	-0.07
DPS12_31544_CDM	-11.18	-12.61	1.43
DPS12_31545_CDM	-8.86	-6.92	-1.94
DPS12_31562_CDM	-6.18	-6.4	0.22
DPS12_31565_CDM	-6.77	-6.8	0.03
DPS12_31568_CDM	-7.38	-7.6	0.22
DPS12_31578_CDM	-7.67	-7.7	0.03
DPS12_31581_CDM	-8.38	-8.2	-0.18
DPS12_31583_CDM	-8.79	-8.8	0.01
DPS12_31584_CDM	-9.16	-9.3	0.14
DPS12_31590_CDM	-12.73	-12.1	-0.63
DPS12_31654_CDM	-7.68	-10.9	3.22
DPS12_31657_CDM	-13.24	-11.7	-1.54

APPENDIX C.3 INVERT ELEVATION COMPARISON

Node Name	Updated Model Elevation	Existing Conditions Model Elevation	Difference
DPS12_31659_CDM	-13.19	-11.9	-1.29
DPS12_31660_CDM	-7.06	-9.06	2
DPS12_31662_CDM	-6.37	-8.44	2.07
DPS12_31667_CDM	-12.47	-11.4	-1.07
DPS12_31669_CDM	-12.83	-11.6	-1.23
DPS12_31678_CDM	-12.67	-11.3	-1.37
DPS12_31682_CDM	-12.33	-11.1	-1.23
DPS12_31702_CDM	-5.16	-5.97	0.81
DPS12_31704_CDM	-5.21	-4.8	-0.41
DPS12_31725_CDM	-11.81	-10.6	-1.21
DPS12_31730_CDM	-10.58	-8.9	-1.68
DPS12_31733_CDM	-9.48	-7.9	-1.58
DPS12_31735_CDM	-8.96	-7	-1.96
DPS12_31738_CDM	-8.53	-4	-4.53
DPS12_31821_CDM	-15.87	-14.8	-1.07
DPS12_31823_CDM	-16.33	-15.65	-0.68
DPS12_31888_CDM	-15.27	-14.5	-0.77
DPS12_31918_CDM	-16.19	-15.4	-0.79

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS07_19038_CDM	-14.00	-14.20	R	5.9	6	-15.32	-14.20	R	5.9	6
DPS07_28860_CDM	-17.80	-17.95	R	9.7	9	-17.80	-18.70	R	9.7	9
DPS07_28865_CDM	-17.95	-18.17	R	9.7	9	-18.70	-18.17	R	9.7	9
DPS07_28867_CDM	-18.20	-18.40	R	11.2	9	-19.06	-18.40	R	11.2	9
DPS07_28879_CDM	-15.90	-16.01	R	9.3	7.5	-15.91	-16.36	R	9.3	7.5
DPS07_28882_CDM	-16.01	-16.15	R	9.3	7.5	-16.36	-16.71	R	9.3	7.5
DPS07_28887_CDM	-16.15	-16.27	R	9.3	7.5	-16.71	-17.16	R	9.3	7.5
DPS07_28889_CDM	-16.27	-16.40	R	9.3	7.5	-17.16	-17.25	R	9.3	7.5
DPS07_28895_CDM	-16.40	-16.60	R	9.7	7.5	-17.25	-16.63	R	9.7	7.5
DPS07_28898_CDM	-16.65	-16.70	R	9.7	9	-16.65	-17.38	R	9.7	9
DPS07_28899_CDM	-16.70	-17.00	R	9.7	9	-17.38	-17.58	R	9.7	9
DPS07_28902_CDM	-17.00	-17.20	R	9.7	9	-17.58	-17.89	R	9.7	9
DPS07_28905_CDM	-17.20	-17.51	R	9.7	9	-17.89	-18.08	R	9.7	9
DPS07_28906_1_CDM	-17.51	-17.55	R	9.7	9	-18.08	-17.55	R	9.7	9
DPS07_28915_CDM	-18.17	-18.20	R	9.7	9	-18.17	-19.06	R	9.7	9
DPS07_28917_CDM	-18.40	-18.45	R	11.2	9	-18.40	-19.14	R	11.2	9
DPS07_29065_CDM	-13.25	-13.30	C	3	NA	-14.51	-14.12	C	3.5	NA
DPS07_29067_CDM	-13.30	-13.45	C	3	NA	-14.53	-14.53	C	3.5	NA
DPS07_29087_CDM	-16.31	-16.49	C	2.5	NA	-16.31	-16.41	C	2.5	NA
DPS07_29088_CDM	-16.49	-17.51	C	3.5	NA	-16.41	-17.51	C	3.5	NA
DPS07_29089_CDM	-13.14	-16.49	C	2.5	NA	-13.14	-16.41	C	2.5	NA
DPS07_29157_CDM	-16.69	-16.90	C	1.5	NA	-16.69	-13.82	C	1.5	NA
DPS07_29165_CDM	-12.06	-16.90	C	2	NA	-12.06	-13.82	C	2	NA
DPS07_29176_CDM	-16.90	-17.10	R	3	3.3	-13.82	-13.06	C	3	NA
DPS07_29183_CDM	-13.91	-17.50	C	2	NA	-13.91	-13.86	C	2	NA
DPS07_29189_1_CDM	-13.27	-17.90	C	1.75	NA	-13.27	-14.61	C	1.75	NA
DPS07_29189_2_CDM	-13.27	-17.90	C	1.25	NA	-13.27	-14.61	C	1.25	NA
DPS07_29201_CDM	-15.52	-17.10	E	1.125	1.875	-15.52	-13.06	E	1.125	1.875
DPS07_29203_CDM	-17.10	-17.20	R	3.5	3.83	-17.10	-13.12	C	3.5	NA
DPS07_29205_CDM	-17.20	-17.50	R	3.5	3.83	-13.12	-13.86	C	3.5	NA
DPS07_29206_CDM	-17.50	-17.90	R	3.5	3.83	-13.86	-14.61	C	3.5	NA
DPS07_29207_CDM	-17.90	-17.95	R	3.5	3.83	-14.61	-17.95	C	3.5	NA
DPS07_29210_CDM	-12.84	-17.50	C	2	NA	-12.84	-13.86	C	2	NA
DPS07_29219_CDM	-14.27	-14.63	C	1.5	NA	-14.27	-14.58	C	1.5	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS07_29220_CDM	-14.63	-18.17	C	2	NA	-14.37	-18.17	C	2	NA
DPS07_29230_CDM	-13.56	-18.09	C	1.5	NA	-13.56	-14.45	C	1.5	NA
DPS07_29255_CDM	-18.45	-18.50	R	11.2	9	-19.14	-18.50	R	11.2	9
DPS07_29259_CDM	-18.09	-18.40	C	1.5	NA	-14.52	-18.40	C	1.5	NA
DPS07_29288_CDM	-12.85	-13.25	C	1.75	NA	-12.85	-13.92	C	2	NA
DPS07_29298_1_CDM	-13.39	-13.45	C	3.5	NA	-14.07	-14.53	C	3.5	NA
DPS07_29301_CDM	-13.50	-13.60	C	3	NA	-14.94	-15.10	C	3.5	NA
DPS07_29302_CDM	-13.60	-13.70	R	3	3.3	-15.10	-15.06	C	3.5	NA
DPS07_29310_CDM	-13.70	-13.80	R	3	3.3	-15.06	-15.26	C	3.5	NA
DPS07_29321_CDM	-13.80	-14.00	R	3	3.3	-15.46	-15.32	C	3.5	NA
DPS07_29385_CDM	-10.42	-13.30	C	2	NA	-10.42	-11.19	C	2	NA
DPS07_29386_CDM	-13.30	-13.39	C	3.5	NA	-11.19	-13.58	C	3.5	NA
DPS07_29387_CDM	-13.45	-13.50	C	3	NA	-14.53	-14.83	C	3.5	NA
DPS07_29393_CDM	-13.16	-13.30	C	3	NA	-13.16	-11.19	C	3	NA
DPS07_29458_CDM	-12.76	-16.70	C	2	NA	-12.76	-12.67	C	2	NA
DPS07_29459_CDM	-16.70	-16.90	R	3	3.3	-12.67	-13.22	C	3	NA
DPS07_29460_CDM	-16.05	-16.70	C	2	NA	-16.05	-12.67	C	2	NA
DPS07_29476_CDM	-15.10	-15.25	R	3.5	3.8	-15.80	-16.02	C	3.5	NA
DPS07_29479_CDM	-15.25	-15.45	R	4	4.3	-16.02	-16.77	C	3.5	NA
DPS07_29506_CDM	-13.93	-15.10	R	3.5	3.8	-15.62	-15.80	C	3.5	NA
DPS07_29507_CDM	-13.85	-13.93	R	3	3.5	-15.13	-15.40	C	3.5	NA
DPS07_29554_CDM	-15.45	-15.65	R	4	4.3	-16.77	-16.47	C	3.5	NA
DPS07_29573_CDM	-16.55	-16.65	R	3.5	3.8	-17.29	-16.65	C	3	NA
DPS07_29575_CDM	-16.25	-16.55	R	3.5	3.8	-17.12	-17.29	C	3	NA
DPS07_29576_CDM	-15.65	-16.65	R	4	4.3	-16.47	-16.65	C	3.5	NA
DPS07_29599_CDM	-16.05	-16.25	R	3.5	3.8	-16.98	-17.12	C	3	NA
DPS07_29607_CDM	-15.90	-16.05	R	3.5	3.8	-16.89	-16.98	C	3	NA
DPS07_29656_CDM	-15.80	-15.90	R	3.5	3.8	-16.18	-16.89	C	3	NA
DPS07_29658_CDM	-15.75	-15.80	R	3	3.5	-16.22	-15.80	C	3	NA
DPS07_29661_CDM	-15.60	-15.75	R	3	3.5	-15.60	-16.22	C	3	NA
DPS07_30095_CDM	-14.30	-14.81	C	3	NA	-14.43	-14.96	C	3	NA
DPS07_30096_CDM	-14.81	-15.80	C	3	NA	-15.08	-16.18	C	3	NA
DPS07_30103_CDM	-13.72	-14.00	C	2.5	NA	-13.72	-13.91	C	3	NA
DPS07_30104_CDM	-14.00	-14.30	C	3	NA	-14.11	-14.28	C	3	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS07_30112_CDM	-15.40	-15.50	R	3	3.5	-15.40	-16.26	R	3	3.5
DPS07_30114_CDM	-15.50	-15.60	R	3	3.5	-16.26	-15.60	R	3	3.5
DPS07_30134_CDM	-14.12	-14.95	C	2.5	NA	-14.12	-14.77	C	2.5	NA
DPS07_30135_CDM	-14.95	-15.05	C	3	NA	-15.04	-15.05	C	3	NA
DPS07_30189_CDM	-14.00	-14.15	R	4	4.5	-14.00	-14.88	C	4.5	NA
DPS07_30190_CDM	-13.21	-13.20	C	1.75	NA	-13.21	-13.20	C	1.5	NA
DPS07_30192_CDM	-13.20	-13.40	R	3	3.5	-13.92	-13.40	C	3	NA
DPS07_30193_CDM	-13.17	-13.20	C	2.25	NA	-13.17	-13.20	C	2	NA
DPS07_30194_CDM	-13.40	-13.50	R	3	3.5	-13.40	-14.75	C	3	NA
DPS07_30195_CDM	-13.50	-13.70	R	3	3.5	-14.75	-13.70	C	3	NA
DPS07_30197_CDM	-14.15	-14.35	R	4	4.5	-14.81	-15.79	C	4	NA
DPS07_30326_CDM	-14.35	-14.85	R	4	4.5	-15.79	-15.56	C	4	NA
DPS07_30327_CDM	-14.85	-15.90	R	4	4.5	-15.56	-15.90	C	4	NA
DPS07_30346_CDM	-9.97	-15.90	C	1.75	NA	-15.45	-15.90	C	1.75	NA
DPS07_30522_CDM	-14.54	-14.55	R	3	3.5	-15.38	-15.57	C	3	NA
DPS07_30529_CDM	-14.56	-14.63	R	4	4.3	-15.16	-15.32	C	4	NA
DPS07_30532_CDM	-15.70	-15.76	R	4	4.3	-15.42	-16.19	C	4	NA
DPS07_30536_CDM	-15.76	-15.82	R	4	4.3	-16.19	-16.07	C	4	NA
DPS07_30541_CDM	-15.82	-15.90	R	4	4.3	-16.07	-15.90	C	4	NA
DPS07_30556_CDM	-14.63	-15.70	R	4	4.3	-15.32	-15.42	R	4	4.3
DPS07_30559_CDM	-13.06	-14.18	C	2.5	NA	-13.06	-13.83	C	2	NA
DPS07_30560_CDM	-14.18	-14.55	C	3	NA	-13.91	-15.05	C	2.5	NA
DPS07_30561_CDM	-14.55	-14.56	R	4	4.3	-15.57	-15.16	C	4	NA
DPS07_30566_CDM	-14.48	-14.55	C	3	NA	-16.21	-14.27	C	2.5	NA
DPS07_30570_CDM	-10.81	-15.90	C	1.75	NA	-14.72	-15.90	C	1.75	NA
DPS07_30657_CDM	-13.02	-13.40	C	3	NA	-12.97	-13.86	C	3	NA
DPS07_30658_CDM	-13.40	-13.65	R	3	3.5	-13.86	-14.20	C	3.5	NA
DPS07_30676_CDM	-11.96	-12.20	C	2	NA	-11.96	-12.80	C	2	NA
DPS07_30682_CDM	-12.20	-13.02	C	3	NA	-12.27	-12.97	C	3	NA
DPS07_30683_CDM	-12.38	-12.20	C	2	NA	-12.38	-12.70	C	2	NA
DPS07_30758_CDM	-13.65	-13.85	R	3	3.5	-14.20	-15.13	C	3.5	NA
DPS07_30805_CDM	-13.87	-14.48	C	2	NA	-13.87	-14.06	C	2	NA
DPS07_31779_CDM	-12.55	-12.75	C	2.5	NA	-12.55	-13.82	C	2.5	NA
DPS07_31780_CDM	-13.05	-13.48	C	3	NA	-14.55	-13.46	C	3	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS07_31781_CDM	-9.02	-13.05	C	1.5	NA	-9.02	-14.05	C	1.5	NA
DPS07_31784_CDM	-13.48	-13.76	C	3.5	NA	-13.46	-16.21	C	3.5	NA
DPS07_31787_CDM	-13.76	-14.02	C	4	NA	-16.21	-15.42	C	3	NA
DPS07_31791_CDM	-14.02	-14.45	C	4	NA	-15.42	-15.64	C	4	NA
DPS07_31793_CDM	-14.45	-15.22	C	4	NA	-15.64	-16.06	C	3	NA
DPS07_31794_CDM	-15.22	-16.80	C	4	NA	-16.06	-16.45	C	3	NA
DPS07_31797_CDM	-9.24	-16.80	C	2	NA	-9.24	-16.45	C	2	NA
DPS07_31798_CDM	-16.79	-16.80	C	2.5	NA	-16.45	-16.80	C	3	NA
DPS07_31804_CDM	-12.75	-13.05	C	3	NA	-13.82	-14.05	C	3	NA
DPS07_31863_CDM	-6.97	-13.48	C	1.5	NA	-6.97	-13.46	C	1.5	NA
DPS12_28871_CDM	-15.00	-15.18	R	8.2	7.5	-15.00	-15.92	R	8.2	7.5
DPS12_28874_CDM	-15.18	-15.90	R	8.2	7.5	-15.92	-15.91	R	8.2	7.5
DPS12_28922_CDM	-14.96	-15.00	R	8.2	7.5	-14.96	-15.69	R	8.2	7.5
DPS12_28924_CDM	-14.92	-14.95	R	8.2	7.5	-15.69	-14.95	R	8.2	7.5
DPS12_28930_1_CDM	-14.90	-15.40	R	7.7	14.1	-16.28	-16.19	R	7.7	14.1
DPS12_28930_2_CDM	-14.90	-14.92	R	8.2	7.5	-16.28	-15.69	R	8.2	7.5
DPS12_28931_CDM	-12.50	-12.80	R	7.5	9.9	-12.50	-13.53	R	7	10
DPS12_29397_CDM	-10.75	-10.80	R	6	5	-11.12	-11.49	R	5.5	5
DPS12_29402_CDM	-10.80	-10.85	R	5.8	5	-11.61	-11.76	R	5.5	5
DPS12_29407_CDM	-10.85	-10.90	R	5.8	5	-11.78	-12.03	R	5.5	5
DPS12_29414_CDM	-10.90	-11.10	R	6	5.1	-12.18	-12.32	R	5.5	5
DPS12_30291_CDM	-15.40	-15.65	R	7.9	14.1	-16.70	-16.33	R	7.9	14.1
DPS12_30480_CDM	-14.00	-14.25	R	7.3	10	-14.85	-15.24	R	7	10
DPS12_30497_CDM	-14.25	-14.50	R	7.3	10	-15.27	-15.22	R	7	10
DPS12_30732_CDM	-13.60	-14.00	R	7.3	10	-14.66	-14.85	R	7	10
DPS12_30738_CDM	-13.20	-13.60	R	7.3	10	-14.57	-14.66	R	7	10
DPS12_30766_CDM	-12.80	-13.20	R	7.5	9.9	-13.53	-14.13	R	7	10
DPS12_31024_CDM	-7.16	-8.70	R	4	4.33	-7.43	-13.02	C	5	NA
DPS12_31027_CDM_1	-8.70	-9.40	C	6	NA	-13.02	-11.77	C	6	NA
DPS12_31027_CDM_2	-8.70	-9.40	C	6	NA	-11.77	-9.40	C	6	NA
DPS12_31036_CDM	-6.28	-8.60	C	1.5	NA	-6.28	-7.85	C	1.5	NA
DPS12_31037_1_CDM	-8.60	-6.13	C	1.75	NA	-7.85	-6.13	C	1.75	NA
DPS12_31037_2_CDM	-8.60	-8.70	R	3	3.33	-7.85	-7.96	C	3	NA
DPS12_31041_CDM	-7.96	-8.70	R	3.5	3.83	-7.95	-8.70	C	3.5	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS12_31042_1_CDM	-7.03	-7.16	C	3	NA	-7.03	-7.43	C	3	NA
DPS12_31047_1_CDM	-6.61	-7.03	C	3	NA	-7.01	-7.03	C	3	NA
DPS12_31072_CDM	-6.58	-6.61	C	2.5	NA	-6.58	-7.01	C	2.5	NA
DPS12_31170_1_CDM	-6.89	-8.04	C	3	NA	-8.71	-8.04	C	3	NA
DPS12_31170_2_CDM	-6.89	-8.04	C	1.25	NA	-6.89	-6.20	C	1.25	NA
DPS12_31207_CDM	-8.00	-8.28	C	3	NA	-7.21	-7.20	C	3.5	NA
DPS12_31222_1_CDM	-8.28	-8.60	C	1.5	NA	-7.40	-7.85	C	1.5	NA
DPS12_31222_CDM	-8.28	-8.60	R	3	3.33	-7.40	-7.85	C	3	NA
DPS12_31223_1_CDM	-6.16	-6.89	C	2.5	NA	-6.16	-8.71	C	2.5	NA
DPS12_31245_CDM	-3.60	-8.28	C	1.25	NA	-3.60	-7.20	C	1.25	NA
DPS12_31264_CDM	-10.41	-12.46	R	3.5	3.83	-10.41	-12.42	C	3.5	NA
DPS12_31266_CDM	-12.46	-12.51	R	3.5	3.83	-12.42	-12.51	C	3.5	NA
DPS12_31267_CDM	-12.51	-13.15	R	3.5	3.83	-12.51	-12.69	C	3.5	NA
DPS12_31268_CDM	-13.15	-13.45	R	3.5	3.83	-12.79	-13.45	C	3.5	NA
DPS12_31269_CDM	-13.45	-14.90	R	7.2	7	-13.45	-16.28	R	7.2	7
DPS12_31270_CDM	-11.68	-13.45	R	3.5	3.83	-12.42	-13.45	C	3.5	NA
DPS12_31271_CDM	-9.50	-11.68	R	3.5	3.83	-12.36	-12.42	C	3.5	NA
DPS12_31274_1_CDM	-8.04	-8.53	C	1.5	NA	-8.04	-6.24	C	1.5	NA
DPS12_31276_1_CDM	-8.53	-9.06	C	1.5	NA	-6.26	-6.89	C	1.5	NA
DPS12_31278_1_CDM	-9.06	-7.81	C	1.5	NA	-6.89	-8.06	C	1.5	NA
DPS12_31281_CDM	-7.81	-8.16	C	1.75	NA	-8.06	-8.16	C	1.75	NA
DPS12_31323_CDM	-10.51	-11.08	C	3	NA	-14.07	-13.57	C	2.5	NA
DPS12_31324_CDM	-9.68	-10.51	C	2.5	NA	-9.68	-13.97	C	2.5	NA
DPS12_31326_1_CDM	-11.08	-13.22	C	3	NA	-13.47	-14.22	C	2.5	NA
DPS12_31333_CDM	-10.54	-15.82	C	1.75	NA	-10.38	-15.82	C	1.75	NA
DPS12_31337_1_CDM	-13.22	-13.79	C	3	NA	-14.22	-14.83	C	3	NA
DPS12_31338_CDM	-13.79	-14.90	C	4	NA	-14.84	-16.28	C	4	NA
DPS12_31370_CDM	-7.39	-7.42	C	2	NA	-7.39	-7.93	C	2	NA
DPS12_31375_CDM	-7.42	-7.51	C	3	NA	-7.81	-7.78	C	3	NA
DPS12_31380_2_CDM	-7.59	-7.73	R	3.5	3.83	-7.59	-7.80	C	3.5	NA
DPS12_31381_CDM	-7.51	-7.59	R	3.5	3.83	-7.78	-7.59	C	3	NA
DPS12_31383_CDM	-7.73	-7.96	R	3.5	3.83	-7.80	-8.05	C	3.5	NA
DPS12_31464_CDM	-8.82	-9.50	E	3	3.33	-10.27	-12.36	C	3	NA
DPS12_31478_CDM	-8.31	-10.50	C	3	NA	-8.35	-10.52	C	3	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS12_31481_CDM	-10.50	-12.61	C	3	NA	-10.57	-11.13	C	3	NA
DPS12_31483_CDM	-8.00	-12.61	C	2	NA	-8.00	-10.22	C	2	NA
DPS12_31544_1_CDM	-12.61	-12.80	C	2.25	NA	-10.22	-12.80	C	2.25	NA
DPS12_31544_2_CDM	-12.61	-12.80	C	3	NA	-11.18	-12.80	C	3	NA
DPS12_31545_CDM	-6.92	-12.61	C	1.25	NA	-8.86	-10.22	C	1.5	NA
DPS12_31561_CDM	-5.65	-6.40	C	2	NA	-5.65	-6.18	C	2	NA
DPS12_31562_CDM	-6.40	-6.80	R	3.3	3	-6.18	-6.77	C	3	NA
DPS12_31565_CDM	-6.80	-7.60	R	3	3.33	-6.77	-7.34	C	3	NA
DPS12_31568_CDM	-7.60	-7.70	R	3	3.33	-7.38	-7.58	C	3	NA
DPS12_31578_CDM	-7.70	-8.20	R	3	3.33	-7.67	-8.31	C	3	NA
DPS12_31581_CDM	-8.20	-8.80	R	3.5	3.8	-8.38	-8.65	C	4	NA
DPS12_31583_CDM	-8.80	-9.30	R	3.5	3.83	-8.79	-9.16	C	4	NA
DPS12_31584_CDM	-9.30	-10.70	R	4	4.2	-9.16	-10.70	C	4	NA
DPS12_31615_CDM	-3.22	-6.40	C	1.75	NA	-3.22	-6.18	C	1.75	NA
DPS12_31622_CDM	-6.53	-8.44	C	3	NA	-6.53	-6.37	C	3	NA
DPS12_31631_CDM	-3.23	-6.80	C	1.75	NA	-3.23	-6.77	C	1.75	NA
DPS12_31633_CDM	-1.05	-7.60	C	1.25	NA	-1.05	-7.34	C	1.25	NA
DPS12_31637_CDM	-4.12	-7.70	C	1.75	NA	-4.12	-7.58	C	1.75	NA
DPS12_31650_CDM	-5.52	-8.80	C	1.75	NA	-5.52	-8.79	C	1.75	NA
DPS12_31654_CDM_1	-10.90	-12.10	C	3	NA	-7.68	-9.49	C	3	NA
DPS12_31654_CDM_2	-10.90	-12.10	C	3	NA	-10.62	-12.10	C	3	NA
DPS12_31657_CDM	-11.70	-11.90	R	6	5	-13.24	-13.16	R	5.5	5
DPS12_31659_CDM	-11.90	-12.10	R	6	5.1	-13.19	-12.72	R	5.5	5
DPS12_31660_CDM	-9.06	-10.90	C	3	NA	-7.06	-7.68	C	3	NA
DPS12_31662_CDM	-8.44	-9.06	C	3	NA	-6.37	-7.06	C	3	NA
DPS12_31667_CDM	-11.40	-11.60	R	6	5	-12.47	-12.81	R	5.5	5
DPS12_31669_CDM	-11.60	-11.70	R	5.9	5	-12.83	-12.96	R	5.5	5
DPS12_31678_CDM	-11.30	-11.40	R	5.9	5	-12.67	-12.36	R	5.5	5
DPS12_31682_CDM	-11.10	-11.30	R	6.1	5	-12.33	-12.67	R	5.5	5
DPS12_31702_CDM	-5.97	-6.53	C	3	NA	-5.16	-6.53	C	3	NA
DPS12_31704_CDM	-4.80	-5.97	C	3	NA	-5.21	-5.09	C	3	NA
DPS12_31725_CDM	-10.60	-10.75	R	6.2	5	-11.81	-11.12	R	5.5	5
DPS12_31730_CDM	-8.90	-10.60	R	3.5	3.83	-10.58	-11.68	C	3.5	NA
DPS12_31733_CDM	-7.90	-8.90	R	3.5	3.83	-9.48	-10.57	C	3.5	NA

APPENDIX C.4 CONDUIT PARAMATER COMPARISON

Conduit Name	EC Inlet Elev. (ft)	EC Outlet Elev. (ft)	EC Shape	EC Height (ft)	EC Width (ft)	Updated Inlet Elev. (ft)	Updated Outlet Elev. (ft)	Updated Shape	Updated Height (ft)	Updated Width (ft)
DPS12_31735_CDM	-7.00	-7.90	C	3	NA	-8.96	-9.37	C	3	NA
DPS12_31737_CDM	-3.98	-4.00	C	1.75	NA	-3.98	-8.53	C	1.75	NA
DPS12_31738_CDM	-4.00	-7.00	C	3	NA	-8.53	-8.91	C	3	NA
DPS12_31742_CDM	-2.98	-4.00	C	2.5	NA	-2.98	-8.53	C	2.5	NA
DPS12_31821_CDM	-14.80	-14.90	R	7.9	10	-15.87	-16.28	R	7	10
DPS12_31823_CDM	-15.65	-15.80	R	7.8	14.2	-16.33	-15.80	R	7.8	14.2
DPS12_31888_CDM	-14.50	-14.80	R	7.9	10	-15.27	-15.77	R	7	10
DPS12_31918_CDM	-15.39	-15.40	R	7.7	14.1	-16.19	-16.70	R	7.7	14.1
DPS12_80405_CDM	-7.00	-10.54	C	1.5	NA	-7.00	-9.43	C	1.5	NA

D. Rainfall Data

APPENDIX D.1 VALIDATION RAINFALL EVENTS

Date (M/D/Y)	Time (H:M)	Value
9/4/2023	10:00:00 AM	0
9/4/2023	10:15:00 AM	0
9/4/2023	10:30:00 AM	0
9/4/2023	10:45:00 AM	0.01
9/4/2023	11:00:00 AM	0.02
9/4/2023	11:15:00 AM	0.01
9/4/2023	11:30:00 AM	0.05
9/4/2023	11:45:00 AM	0.17
9/4/2023	12:00:00 PM	0.54
9/4/2023	12:15:00 PM	0.65
9/4/2023	12:30:00 PM	0.54
9/4/2023	12:45:00 PM	0.98
9/4/2023	1:00:00 PM	1.24
9/4/2023	1:15:00 PM	0.83
9/4/2023	1:30:00 PM	0.39
9/4/2023	1:45:00 PM	0.37
9/4/2023	2:00:00 PM	0.13
9/4/2023	2:15:00 PM	0.28
9/4/2023	2:30:00 PM	0.23
9/4/2023	2:45:00 PM	0.3
9/4/2023	3:00:00 PM	0.44
9/4/2023	3:15:00 PM	0.09
9/4/2023	3:30:00 PM	0.08
9/4/2023	3:45:00 PM	0.12
9/4/2023	4:00:00 PM	0.06
9/4/2023	4:15:00 PM	0.06
9/4/2023	4:30:00 PM	0
9/4/2023	4:45:00 PM	0
9/4/2023	5:00:00 PM	0
9/4/2023	5:15:00 PM	0
9/4/2023	5:30:00 PM	0
9/4/2023	5:45:00 PM	0
9/4/2023	6:00:00 PM	0
9/4/2023	6:15:00 PM	0
9/4/2023	6:30:00 PM	0
9/4/2023	6:45:00 PM	0
9/4/2023	7:00:00 PM	0
9/4/2023	7:15:00 PM	0
9/4/2023	7:30:00 PM	0
9/4/2023	7:45:00 PM	0
9/4/2023	8:00:00 PM	0
9/4/2023	8:15:00 PM	0
9/4/2023	8:30:00 PM	0
9/4/2023	8:45:00 PM	0
9/4/2023	9:00:00 PM	0
9/4/2023	9:15:00 PM	0
9/4/2023	9:30:00 PM	0
9/4/2023	9:45:00 PM	0

Date (M/D/Y)	Time (H:M)	Value
4/10/2024	0:00	0
4/10/2024	0:15	0
4/10/2024	0:30	0
4/10/2024	0:45	0
4/10/2024	1:00	0
4/10/2024	1:15	0
4/10/2024	1:30	0
4/10/2024	1:45	0
4/10/2024	2:00	0
4/10/2024	2:15	0
4/10/2024	2:30	0
4/10/2024	2:45	0
4/10/2024	3:00	0
4/10/2024	3:15	0
4/10/2024	3:30	0
4/10/2024	3:45	0
4/10/2024	4:00	0
4/10/2024	4:15	0
4/10/2024	4:30	0
4/10/2024	4:45	0
4/10/2024	5:00	0
4/10/2024	5:15	0
4/10/2024	5:30	0
4/10/2024	5:45	0
4/10/2024	6:00	0
4/10/2024	6:15	0
4/10/2024	6:30	0
4/10/2024	6:45	0
4/10/2024	7:00	0.1
4/10/2024	7:15	0.2
4/10/2024	7:30	0.2
4/10/2024	7:45	0.3
4/10/2024	8:00	0
4/10/2024	8:15	0
4/10/2024	8:30	0.3
4/10/2024	8:45	0.3
4/10/2024	9:00	0.7
4/10/2024	9:15	0.3
4/10/2024	9:30	0
4/10/2024	9:45	0
4/10/2024	10:00	0
4/10/2024	10:15	0
4/10/2024	10:30	0.3
4/10/2024	10:45	0.3
4/10/2024	11:00	0.6
4/10/2024	11:15	0.4
4/10/2024	11:30	0.5
4/10/2024	11:45	0.1

APPENDIX D.1 VALIDATION RAINFALL EVENTS

Date (M/D/Y)	Time (H:M)	Value
9/4/2023	10:00:00 PM	0
9/4/2023	10:15:00 PM	0
9/4/2023	10:30:00 PM	0
9/4/2023	10:45:00 PM	0
9/4/2023	11:00:00 PM	0
9/4/2023	11:15:00 PM	0
9/4/2023	11:30:00 PM	0
9/4/2023	11:45:00 PM	0
9/5/2023	12:00:00 AM	0
9/5/2023	12:15:00 AM	0
9/5/2023	12:30:00 AM	0
9/5/2023	12:45:00 AM	0
9/5/2023	1:00:00 AM	0
9/5/2023	1:15:00 AM	0
9/5/2023	1:30:00 AM	0
9/5/2023	1:45:00 AM	0
9/5/2023	2:00:00 AM	0
9/5/2023	2:15:00 AM	0
9/5/2023	2:30:00 AM	0
9/5/2023	2:45:00 AM	0
9/5/2023	3:00:00 AM	0
9/5/2023	3:15:00 AM	0
9/5/2023	3:30:00 AM	0
9/5/2023	3:45:00 AM	0
9/5/2023	4:00:00 AM	0
9/5/2023	4:15:00 AM	0
9/5/2023	4:30:00 AM	0
9/5/2023	4:45:00 AM	0
9/5/2023	5:00:00 AM	0
9/5/2023	5:15:00 AM	0
9/5/2023	5:30:00 AM	0
9/5/2023	5:45:00 AM	0
9/5/2023	6:00:00 AM	0
9/5/2023	6:15:00 AM	0
9/5/2023	6:30:00 AM	0
9/5/2023	6:45:00 AM	0
9/5/2023	7:00:00 AM	0
9/5/2023	7:15:00 AM	0
9/5/2023	7:30:00 AM	0
9/5/2023	7:45:00 AM	0
9/5/2023	8:00:00 AM	0
9/5/2023	8:15:00 AM	0
9/5/2023	8:30:00 AM	0
9/5/2023	8:45:00 AM	0
9/5/2023	9:00:00 AM	0
9/5/2023	9:15:00 AM	0
9/5/2023	9:30:00 AM	0
9/5/2023	9:45:00 AM	0

Date (M/D/Y)	Time (H:M)	Value
4/10/2024	12:00	0.3
4/10/2024	12:15	0.3
4/10/2024	12:30	0.3
4/10/2024	12:45	0.3
4/10/2024	13:00	0.5
4/10/2024	13:15	0.1
4/10/2024	13:30	0.1
4/10/2024	13:45	0
4/10/2024	14:00	0
4/10/2024	14:15	0
4/10/2024	14:30	0
4/10/2024	14:45	0
4/10/2024	15:00	0
4/10/2024	15:15	0
4/10/2024	15:30	0
4/10/2024	15:45	0
4/10/2024	16:00	0
4/10/2024	16:15	0
4/10/2024	16:30	0
4/10/2024	16:45	0
4/10/2024	17:00	0
4/10/2024	17:15	0
4/10/2024	17:30	0
4/10/2024	17:45	0
4/10/2024	18:00	0
4/10/2024	18:15	0
4/10/2024	18:30	0
4/10/2024	18:45	0
4/10/2024	19:00	0
4/10/2024	19:15	0
4/10/2024	19:30	0
4/10/2024	19:45	0
4/10/2024	20:00	0
4/10/2024	20:15	0
4/10/2024	20:30	0
4/10/2024	20:45	0
4/10/2024	21:00	0
4/10/2024	21:15	0
4/10/2024	21:30	0
4/10/2024	21:45	0
4/10/2024	22:00	0
4/10/2024	22:15	0
4/10/2024	22:30	0
4/10/2024	22:45	0
4/10/2024	23:00	0
4/10/2024	23:15	0
4/10/2024	23:30	0
4/10/2024	23:45	0

APPENDIX D.2 NOAA PRECIPITATION FREQUENCY ESTIMATES

by duration for ARI (years):	1	2	5	10	25	50	100	200	500	1000
5-min:	0.55	0.625	0.754	0.867	1.03	1.16	1.3	1.44	1.64	1.8
10-min:	0.806	0.916	1.1	1.27	1.51	1.7	1.9	2.11	2.41	2.64
15-min:	0.983	1.12	1.35	1.55	1.84	2.07	2.32	2.58	2.94	3.22
30-min:	1.49	1.71	2.08	2.41	2.87	3.25	3.64	4.05	4.62	5.06
60-min:	2.03	2.32	2.85	3.34	4.09	4.73	5.42	6.18	7.26	8.14
2-hr:	2.57	2.93	3.61	4.27	5.3	6.21	7.2	8.3	9.9	11.2
3-hr:	2.91	3.31	4.1	4.89	6.17	7.31	8.59	10	12.1	13.9
6-hr:	3.48	3.98	4.98	5.99	7.65	9.14	10.8	12.7	15.5	17.8
12-hr:	4.05	4.69	5.92	7.13	9.06	10.8	12.7	14.8	17.9	20.4
24-hr:	4.65	5.45	6.93	8.32	10.5	12.3	14.4	16.6	19.8	22.4
2-day:	5.3	6.24	7.95	9.53	11.9	14	16.2	18.6	22.1	24.9
3-day:	5.71	6.7	8.5	10.2	12.7	14.9	17.3	19.9	23.7	26.7
4-day:	6.06	7.07	8.93	10.7	13.4	15.7	18.2	20.9	24.8	28.1
7-day:	7.02	8.1	10.1	11.9	14.8	17.3	20	22.9	27.2	30.7
10-day:	7.93	9.08	11.2	13.1	16.1	18.7	21.4	24.4	28.8	32.3
20-day:	10.6	12.1	14.5	16.7	19.9	22.5	25.3	28.3	32.4	35.7
30-day:	13	14.6	17.4	19.8	23.2	26	28.7	31.6	35.6	38.7
45-day:	15.9	18	21.2	23.9	27.7	30.6	33.4	36.3	40.2	43.1
60-day:	18.5	20.8	24.5	27.6	31.6	34.7	37.7	40.7	44.5	47.4

Reference: NOAA, 2018

E. Observed Water Marks

APPENDIX E. OBSERVED WATER MARKS

ID	Address	Event Date	Photo Time	Y	X	HWM	Descriptio
50001	6770 Marshal Foch	4/10/2024	2:41:00 PM	552476.771	3670291.834	-8.356	Mailbox
50002	6770 Marshal Foch	4/10/2024	2:41:00 PM	552479.041	3670291.909	-6.57	Mailbox
50003	6770 Marshal Foch	4/10/2024	2:41:00 PM	552490.5	3670327.275	-6.829	Front lawn
50004	6770 Marshal Foch	4/10/2024	2:41:00 PM	552522.797	3670362.535	-7.619	Tree
50005	6770 Marshal Foch	4/10/2024	2:41:00 PM	552588.754	3670360.77	-7.701	Driveway
50006	6770 Marshal Foch	4/10/2024	2:41:00 PM	552413.787	3670330.512	-7.075	Lawn
50007	6628 General Diaz St	4/10/2024	6:37:00 PM	551524.991	3669872.076	-6.559	Sidewalk
50008	6628 General Diaz St	9/4/2023	6:37:00 PM	551483.917	3669938.818	-7.74	Lawn
50009	6628 General Diaz St	4/10/2024	6:37:00 PM	551506.052	3669869.591	-7.078	ROW
50010	6628 General Diaz St	9/4/2023	6:37:00 PM	551450.502	3669920.962	-8.194	Sidewalk
50011	6628 General Diaz St	9/4/2023	6:37:00 PM	551446.634	3669913.836	-8.478	Sidewalk
50012	6628 General Diaz St	9/4/2023	6:37:00 PM	551446.061	3669913.51	-7.941	Sidewalk
50013	6649 West End Blvd	9/4/2023	After event	550834.916	3666717.36	-6.752	High point in road
50014	6649 West End Blvd	9/4/2023	After event	550814.515	3666679.022	-7.245	Sidewalk
50015	6649 West End Blvd	9/4/2023	After event	550809.297	3666668.846	-7.172	Sidewalk
50019	6135 West End Blvd	9/4/2023	After event	548529.308	3666633.155	-6.301	Sidewalk
50021	6135 West End Blvd	9/4/2023	After event	548478.782	3666698.922	-6.3	Driveway
50022	6135 West End Blvd	9/4/2023	After event	549069.647	3666559.479	-6.257	Driveway
50023	6211 West End Blvd	9/4/2023	After event	549005.725	3666555.848	-6.067	Driveway
50024	6211 West End Blvd	9/4/2023	After event	549005.866	3666555.045	-6.493	ROW
50025	6208 Milne Blvd	4/10/2024	5:08:00 PM	547634.905	3667033.82	-6.213	Neutral ground
50026	6208 Milne Blvd	4/10/2024	5:08:00 PM	547622.714	3667006.357	-6.345	Neutral ground
50027	5716 Louis XIV St	9/4/2023	After event	546117.115	3667941.875	-5.4	Sidewalk
50028	5716 Louis XIV St	9/4/2023	After event	546117.596	3667942.616	-5.365	Sidewalk
50029	5716 Louis XIV St	9/4/2023	After event	546148.661	3667947.521	-5.06	Sidewalk
50030	535 Kenilworth St	9/4/2023	After event	546086.656	3667873.244	-5.192	ROW
50031	5716 Louis XIV St	9/4/2023	After event	546086.988	3667983.372	-5.242	Sidewalk

Note: Coordinate system: WGS 1984

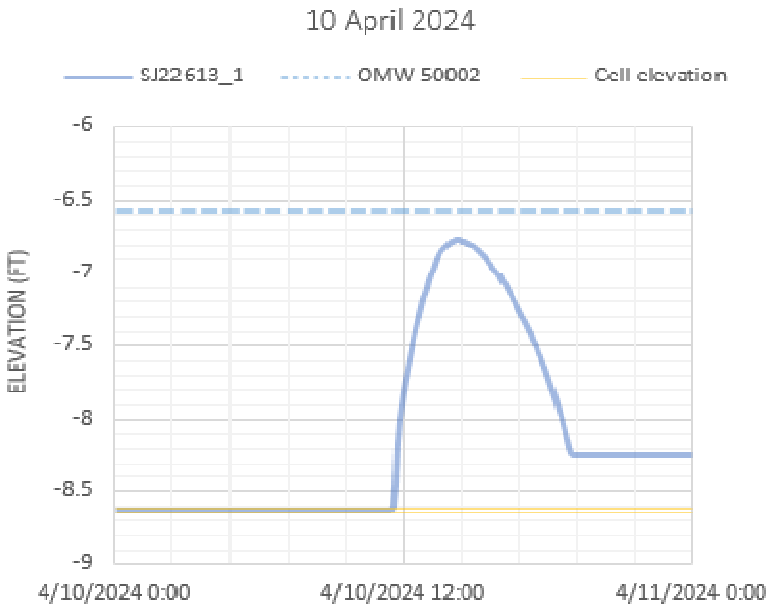
F. Model Sensitivity Log

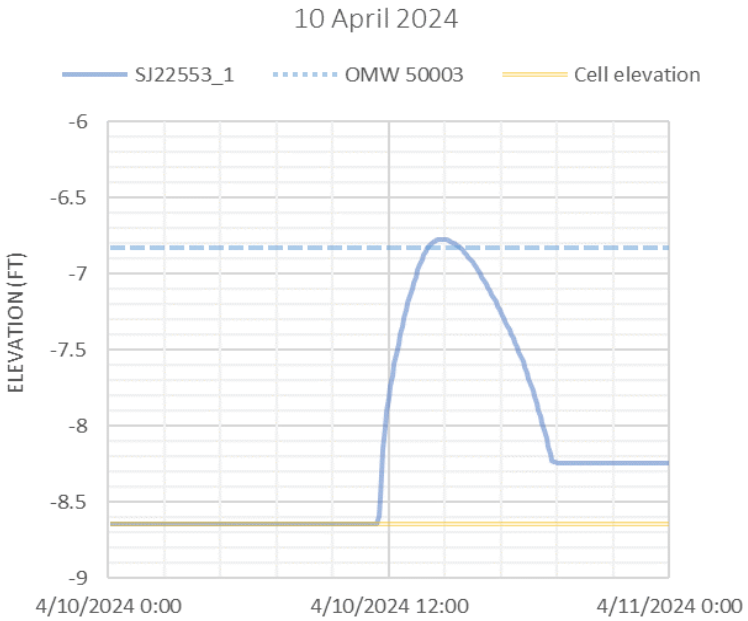
APPENDIX F. SENSITIVITY LOG

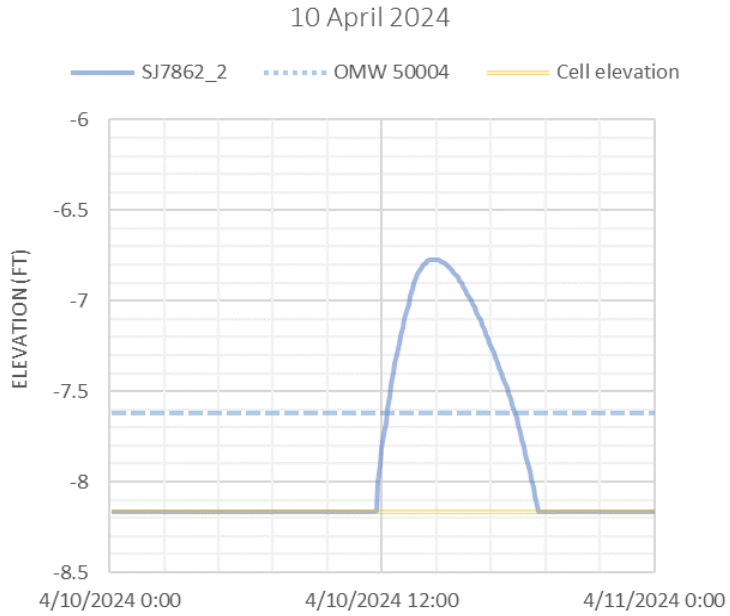
Model ID	Event	Infrastructure Survey	DPS-007	DPS-012	Comments
NO_Sep23_2D_009	4-Sep-23	updated	as in original model	As in original model	
NO_Sep23_2D_009_pumps_SA01	4-Sep-23	updated	Start up and shut off depths as in real event	start up and shut off depths as in real event	
NO_Sep23_2D_009_pumps_SA02	4-Sep-23	updated	Start up and shut off depths as in real event	start up and shut off depths as in real event	
NO_Sep23_2D_012	4-Sep-23	updated	Flows on the pump curve increased from OG model by: 32% for Pump A; 42.5% for Pump C; 42.5% for Pump D	Flows on pump curve decreased 6% from OG model	Recommended for a validation event
NO_10Apr24_2D_009	10-Apr-24	updated	As in orginal model	As in original model	
NO_10Apr24_2D_009_pumps	10-Apr-24	updated	Start up and shut off depths as in real event	Start up and shut off depths as in real event	
NO_10Apr24_2D_009_pumps_SA01	10-Apr-24	updated	Start up and shut off depths as in real event	Start up and shut off depths as in real event; Curve edited, flow decreased by 50%	
NO_10Apr24_2D_009_pumps_SA02	10-Apr-24	updated	Start up and shut off depths as in real event	Start up and shut off depths as in real event; Curve edited, flow decreased by 50%; Initial levels at upstream junctions from pumps increased to 8	
NO_10Apr24_2D_010	10-Apr-24	updated	Flows on the pump curve increased from OG model by: 14.5% for Pump A; 24% for Pump C; 24% for Pump D	Flows on pump curve decreased 6% from OG model	
NO_10Apr24_2D_012	10-Apr-24	updated	Flows on the pump curve increased from OG model by: 32% for Pump A; 42.5% for Pump C; 42.5% for Pump D	Flows on the pump curve decreased by 6% comparing to the original model	Recommended for a validation event

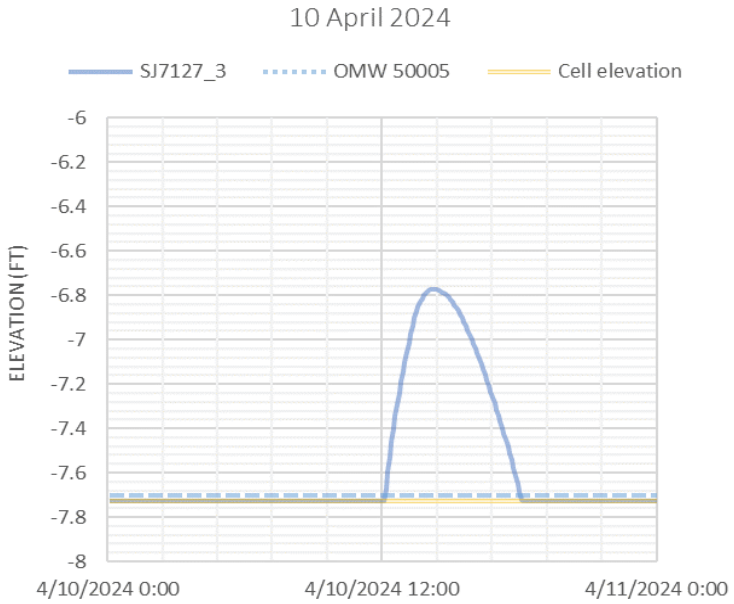
G. Validation Efforts – Graphical Visualization

APPENDIX G.1 APRIL 10, 2024 VALIDATION - OBSERVED WATER MARK TO MODEL TIME SERIES COMPARISON

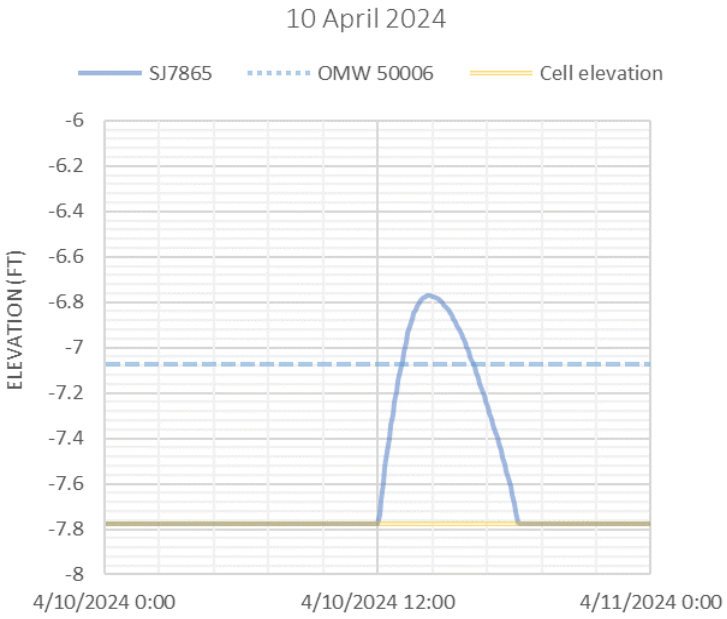


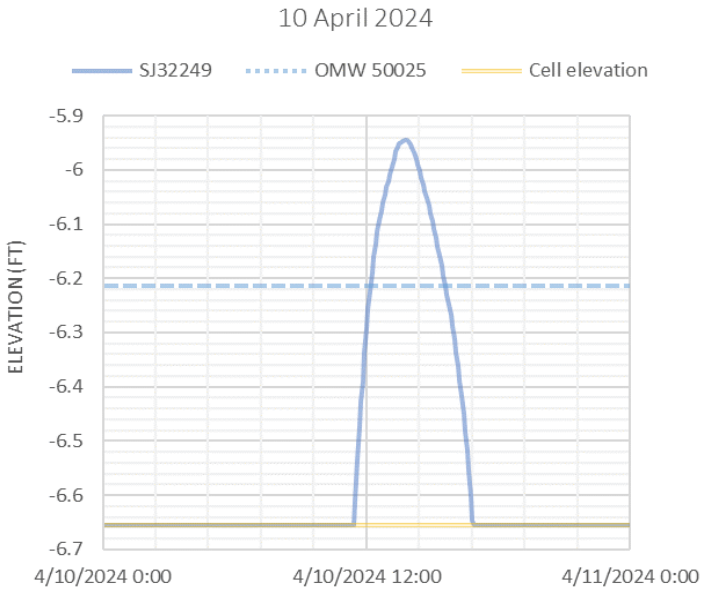


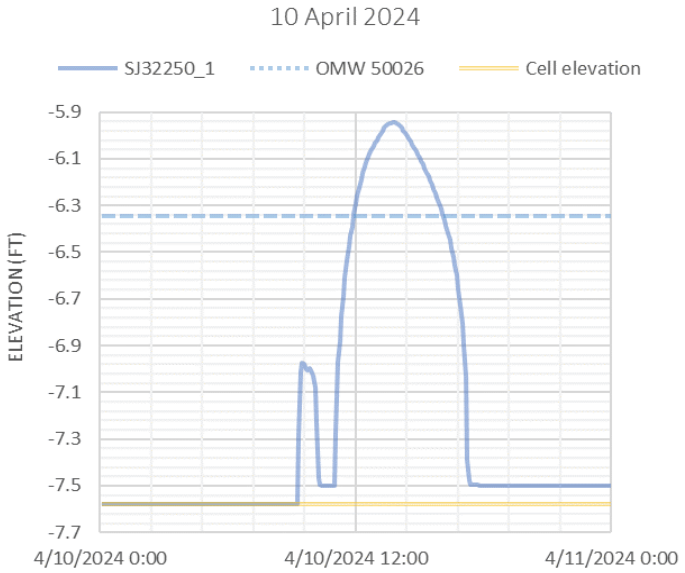




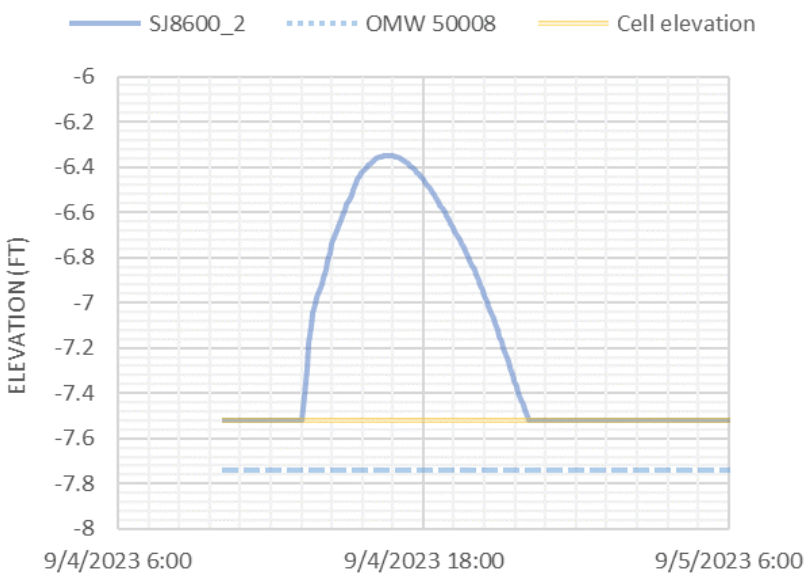
APPENDIX G.1 APRIL 10, 2024 VALIDATION - OBSERVED WATER MARK TO MODEL TIME SERIES COMPARISON

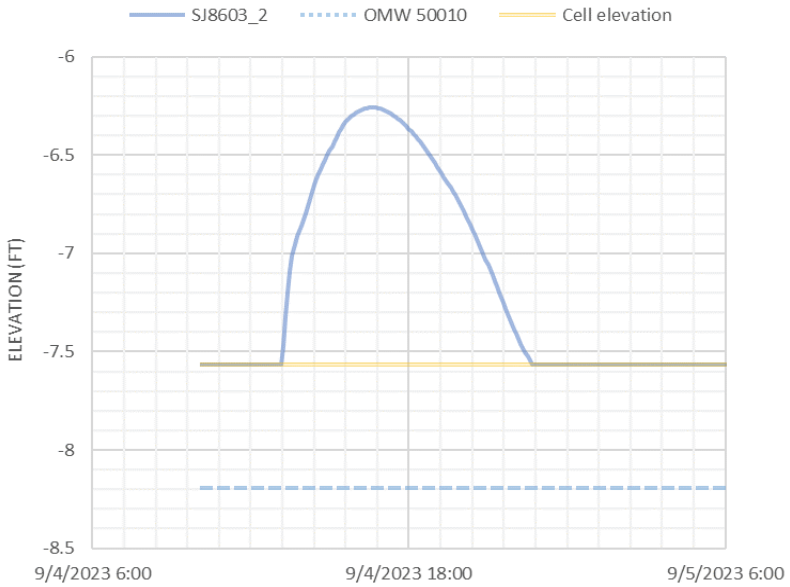


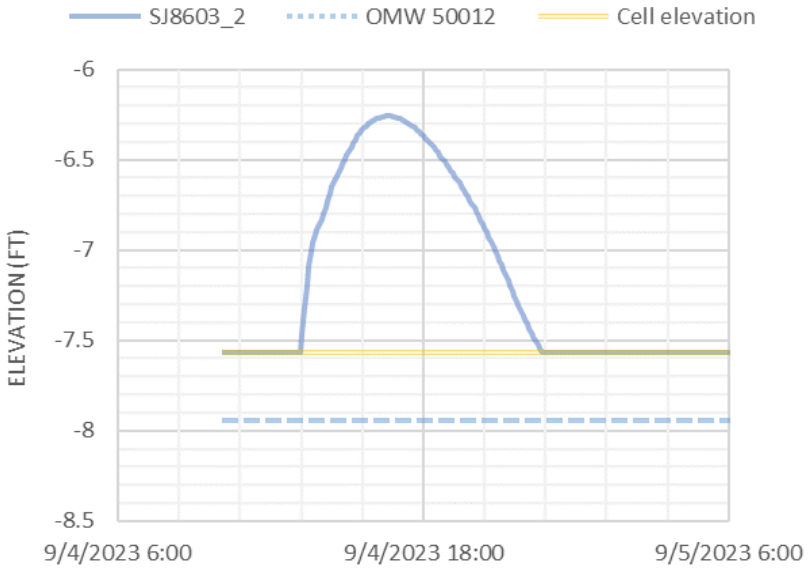


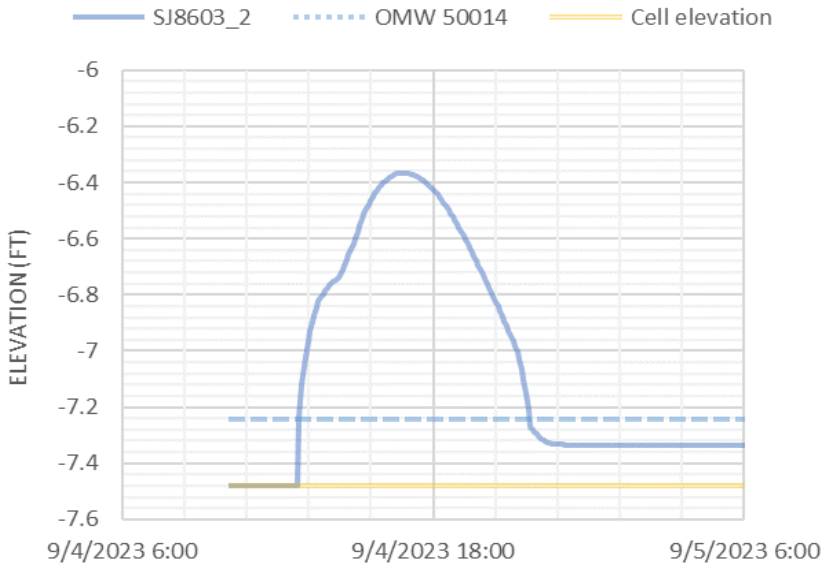


APPENDIX G.2 SEPTEMBER 4, 2023 VALIDATION - OBSERVED WATER MARK TO MODEL TIME SERIES COMPARISON

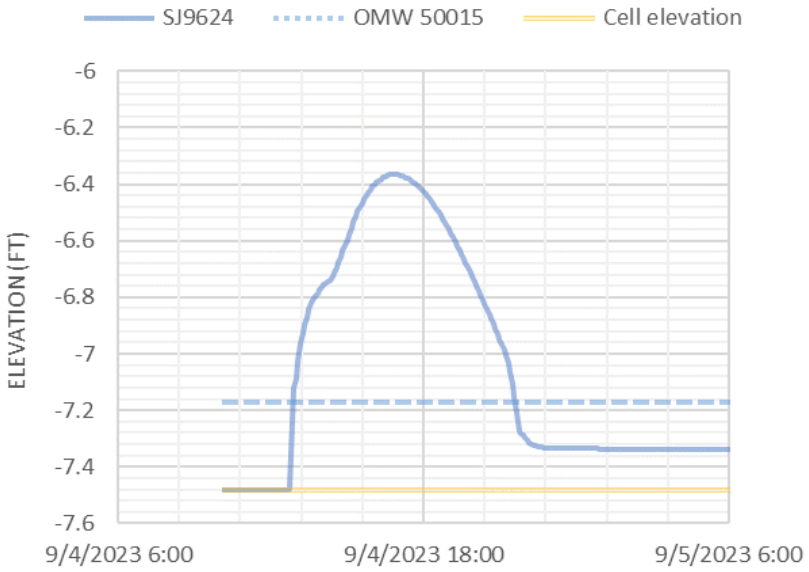


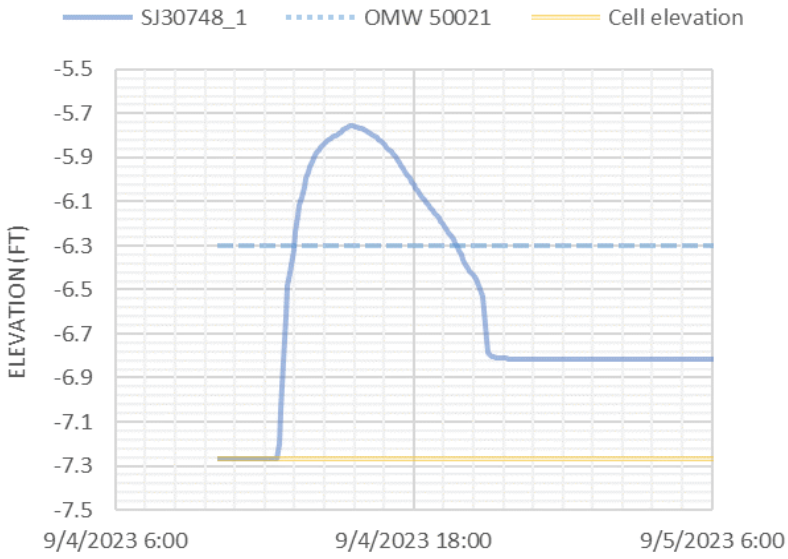


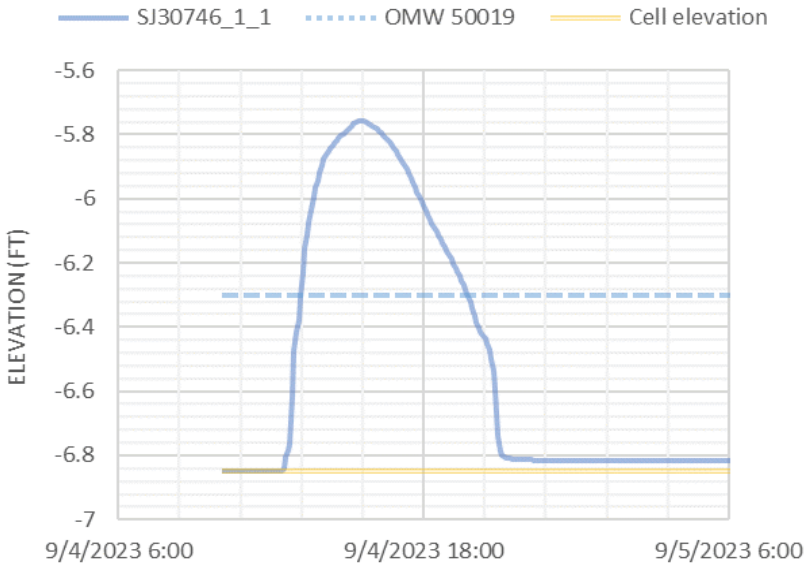


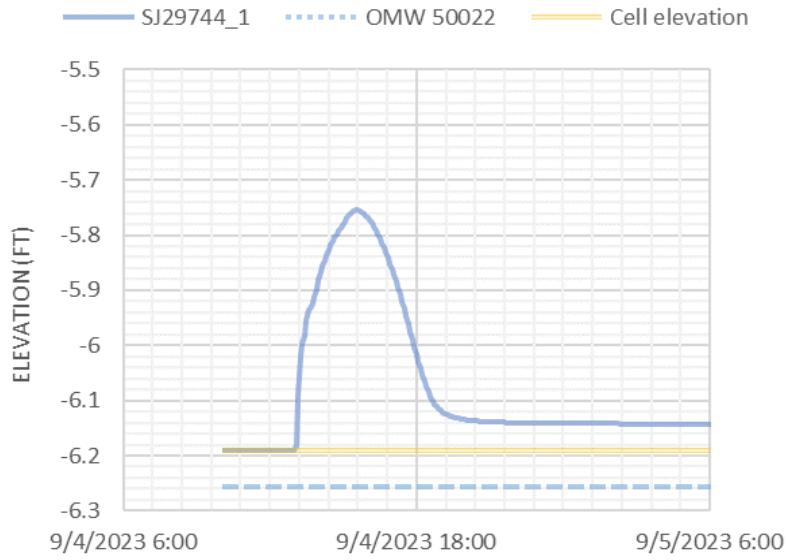


APPENDIX G.2 SEPTEMBER 4, 2023 VALIDATION - OBSERVED WATER MARK TO MODEL TIME SERIES COMPARISON

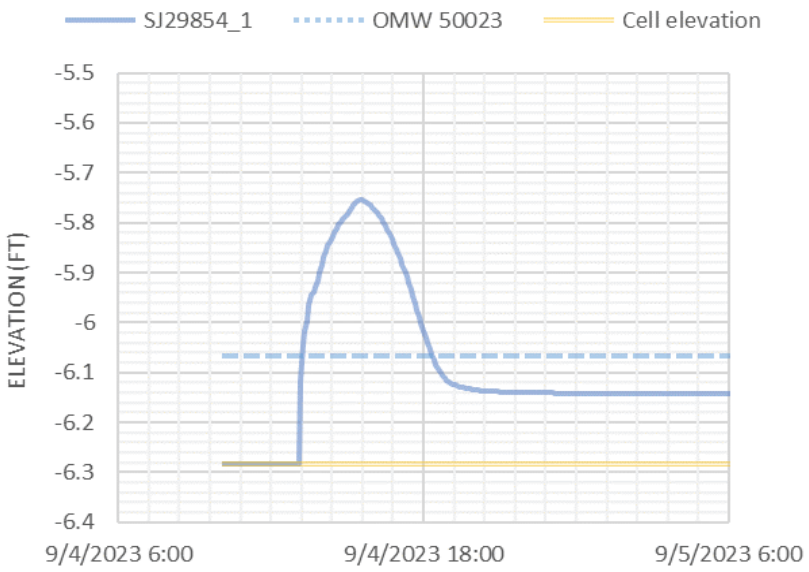


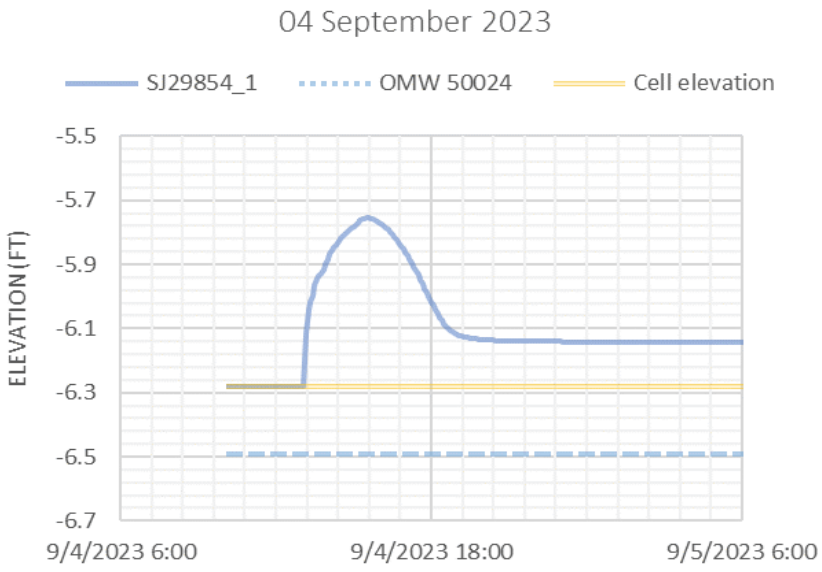


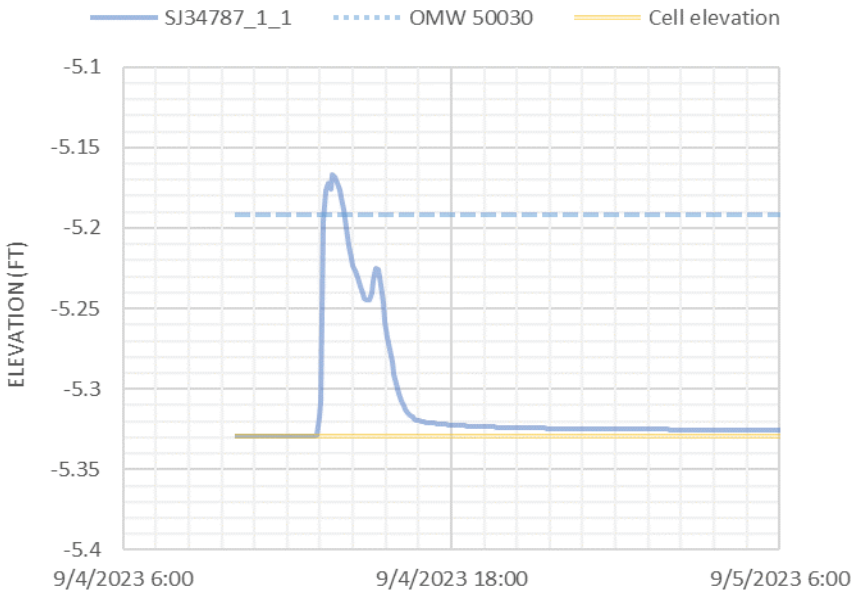




APPENDIX G.2 SEPTEMBER 4, 2023 VALIDATION - OBSERVED WATER MARK TO MODEL TIME SERIES COMPARISON







H. Existing Model Data Tags

APPENDIX H. MODEL TAGS

Feature	Tag	Managed Data Source
CONDUITS	BoundaryModel	Inherited from Existing Conditions model supplied by CNO
CONDUITS	CityOriginal	Inherited from Existing Conditions model supplied by CNO
CONDUITS	Street	Inherited from Existing Conditions model supplied by CNO
CONDUITS	Street_trimmed	Trimmed to 2D boundary
CONDUITS	SWBOriginal	Inherited from Existing Conditions model supplied by CNO
CONDUITS	SWBOriginal_trimmed	Inherited from Existing Conditions model supplied by CNO and trimmed
CONDUITS	BattureSurvey_CityOriginal	Inherited from Existing Conditions model supplied by CNO with Batture survey update
CONDUITS	BattureSurvey_SWBOriginal	Inherited from Existing Conditions model supplied by CNO with Batture survey update
CONDUITS	2D_OUT	Added based on the topography
JUNCTIONS	+3toRIM	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	-4to0	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	Converted	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	EB_Existing_DPS06_DPS07_DPS12	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	rim+3	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	Split	Inherited from Existing Conditions model supplied by CNO
JUNCTIONS	Connect2D	Junctions used in 2D modeling, part of them updated due to Batture survey
ORIFICE	2D	Orifices used to connect 1D junctions with 2D junctions
OUTFALLS	2D_OUT	Added based on the topography
OUTFALLS	EB_Existing_DPS06_DPS07_DPS12	Inherited from Existing Conditions model supplied by CNO
PUMPS	BoundaryModel	Inherited from Existing Conditions model supplied by CNO
PUMPS	SWBOriginal	Inherited from Existing Conditions model supplied by CNO
PUMPS	SWBOriginal_updated	Updated to represent 100% capacity
STORAGE AREAS	Converted	Inherited from Existing Conditions model supplied by CNO
STORAGE AREAS	EB_Existing_DPS06_DPS07_DPS12	Inherited from Existing Conditions model supplied by CNO
STORAGE AREAS	unique values (negative)	Inherited from Existing Conditions model supplied by CNO
SUBCATCHMENTS	EB_Existing_DPS06_DPS07_DPS12	Inherited from Existing Conditions model supplied by CNO
SUBCATCHMENTS	Trimmed	Inherited from Existing Conditions model supplied by CNO

Appendix C. Blue and Green Stormwater Infrastructure Details

Overview

Blue		Green		
Surface	Subsurface	Parcel-Based	Surface	Subsurface
		6. Downspout Disconnection	11. Tree Planting	
		7. Rain Barrel/Cisterns	12. Tree Box	
1. Detention Basin		8. Stormwater Planter Box	13. Curb Stormwater Box/Tree Trench	16. Permeable Pavement
2. Floodable Spaces	4. Detention Vault	9. Rain Garden	14. Bioretention	17. Infiltration Trench
3. Floodable Street	5. Box Culvert Street	10. Vegetative Roof	15. Vegetated Bioswale	18. Subsurface Infiltration Chamber

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Detention Basin

Description

- Vegetated depression designed to capture a large amount of rainwater and releases it slowly into the ground and the drainage system.
- Slows the flow before releasing it into a smaller outlet.

O&M Acceptance

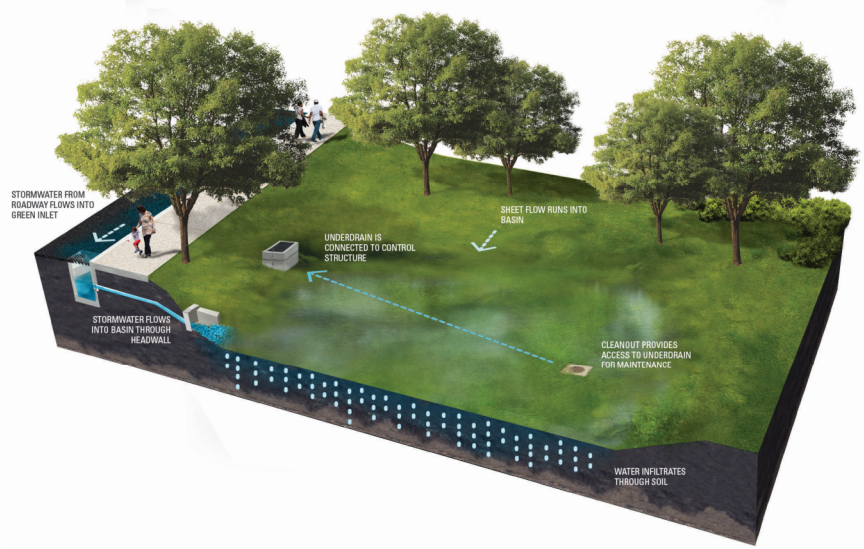
- **Weekly** = Debris removal, Watering & weeding during establishment (if trees & shrubs are present), Mowing turf grass, visual inspection of inlets
- **Monthly** – Weeding
- **Annually** – Mulching (if trees & shrubs are present), Regrading eroded areas, reseeding turf grass as needed, replacing plants as needed (if trees & shrubs are present), pipe inspection and clean out

Cost/Implementation Challenges

- $63,021-$112,038* per acre of impervious surface treated
- For ponds, the annual cost of routine maintenance is typically about 2-6% of the construction cost (King & Hagan, 2011)

Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Medium, Mosquito breeding nuisance If improperly maintained or if shallow pools of water form for more than 3 days.
- Addresses Volume: High



https://ready.nola.gov/green-infrastructure/

* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl

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Floodable Spaces

Description

- After a heavy rain, the open space may be flooded and not usable by people. But, after the water subsides, the area will again be usable as parkland for people and wildlife.
- Parklands, playgrounds, and urban open spaces can be designed specifically to accept excess rainwater ("sheet flow" that moves across the ground).

O&M Acceptance

- Clean up activities expected after flooding events.
- **Routine** – inspection and cleaning trash, debris, and sediment from pre-treatment devices

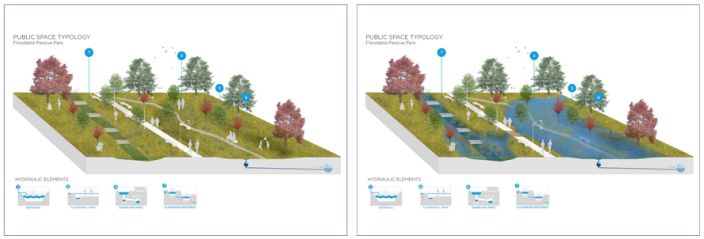
Cost/Implementation Challenges

- Higher cost of implementation with respect to traditional gray infrastructure
- Cost benefits from community visibility

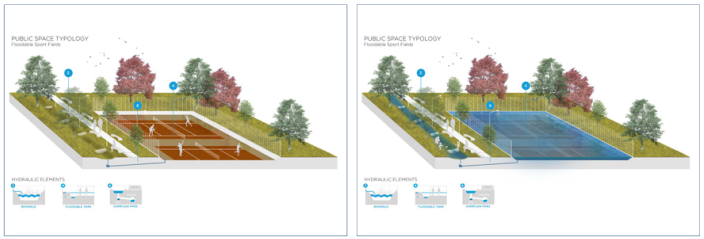
Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Medium
- Addresses Volume: High

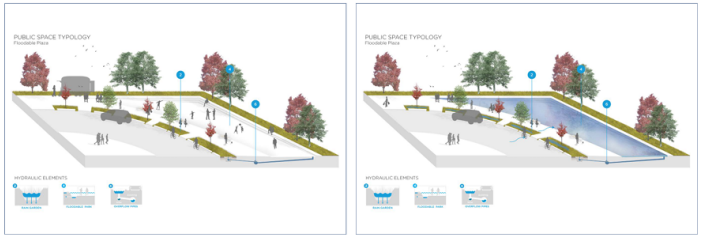
Floodable Passive Park



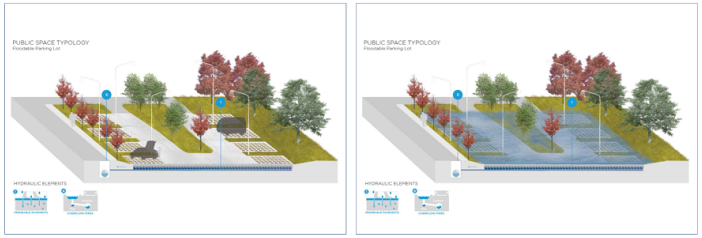
Floodable Athletic Fields



Floodable Wet Plaza



Floodable Parking Lot



Floodable Street

Description

- Also known as collector streets, these are temporarily flooded and/or used for stormwater conveyance.
- Coordination with a wider stormwater management strategy is required.

O&M Acceptance

- High operations and maintenance

Cost/Implementation Challenges

- Requires careful design/consideration

Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Low, during storm events, access to street is loss
- Addresses Volume: High

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Detention Vault

Description

- Box-shaped underground stormwater storage facilities typically constructed with reinforced concrete.
- Typically constructed with large diameter metal or plastic pipe.
- Serve as an alternative to surface dry detention for stormwater quantity control, particularly for space-limited areas where there is not adequate land for a dry detention basin or multi-purpose detention area.

O&M Acceptance

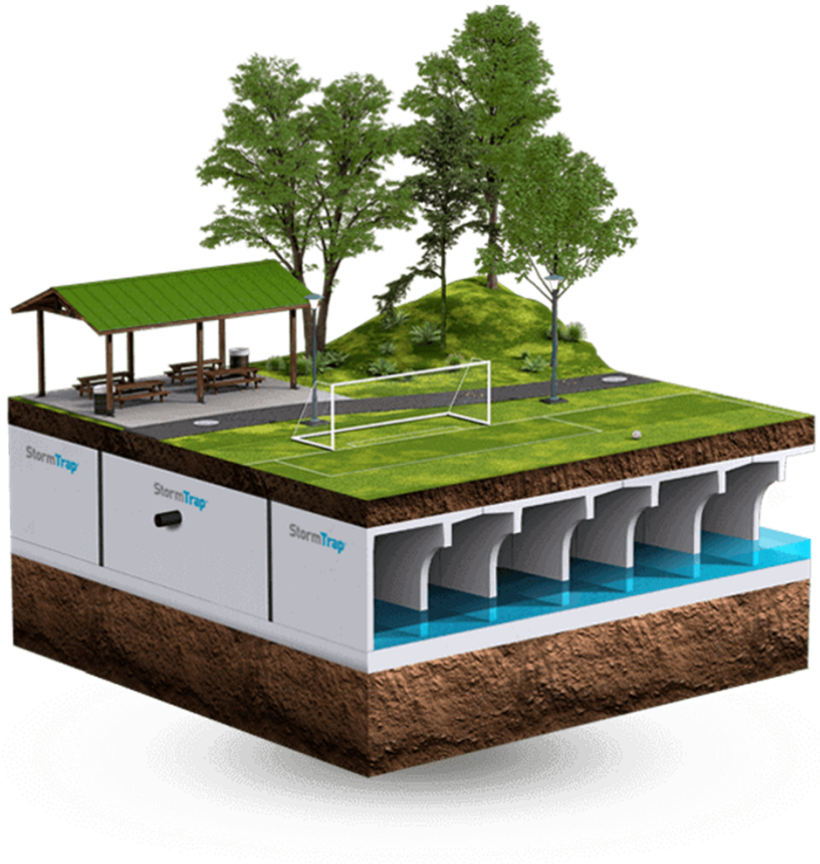
- **Annually-** Remove any trash/debris and sediment buildup in the underground vaults or tansk
- **As needed, based on inspection –** Perform structural repairs to inlets and outlets.

Cost/Implementation Challenges

- High cost
- Dependent on types of material
- Ex. Concrete vaults, metal, or plastic pipe
- $10-12 per cubic foot*

Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Low
- Addresses Volume: Should be paired with green practices to increase storage capacity



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Box Culvert Street

Description

- Where pipe solutions are inappropriate, box culverts underneath the street can increase rainwater capacity.

O&M Acceptance

- Requires careful design/consideration.

Cost/Implementation Challenges

- Initial high cost to implement. Geotech design required.

Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Medium
- Addresses Volume: High

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Downspout Disconnection

Description

- Simple practice of rerouting rooftop drainage pipes from draining rainwater into the storm sewer to draining it into rain barrels, cisterns, or permeable areas.
- Can be used to store stormwater and/or allow stormwater to infiltrate into the soil.

O&M Acceptance

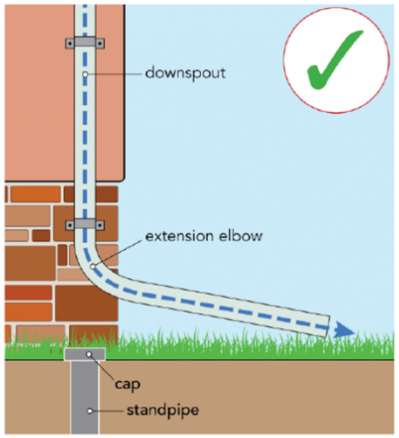
- Low maintenance required

Cost/Implementation Challenges

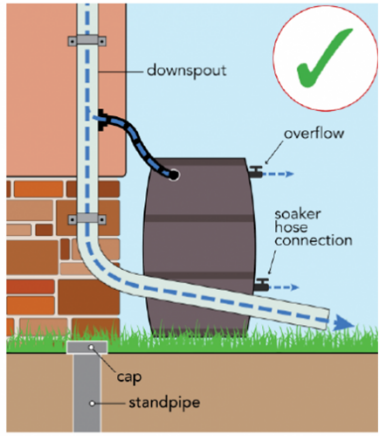
- Low cost

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: High
- Addresses Volume: Low, prefer disconnection from stormwater system via other methods such as rain barrel/cistern/rain garden/etc.



DOWNSPOUT DISCONNECTED FROM SEWER SYSTEM



DOWNSPOUT CONNECTED TO RAIN BARREL

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Rain Barrel/Cisterns

Description

- Collects rain runoff from the roof of a building through a downspout.
- Water can be stored for later use or held and released slowly back into the ground.
- Stored water can be used for many things, including to water gardens or wash cars.

O&M Acceptance

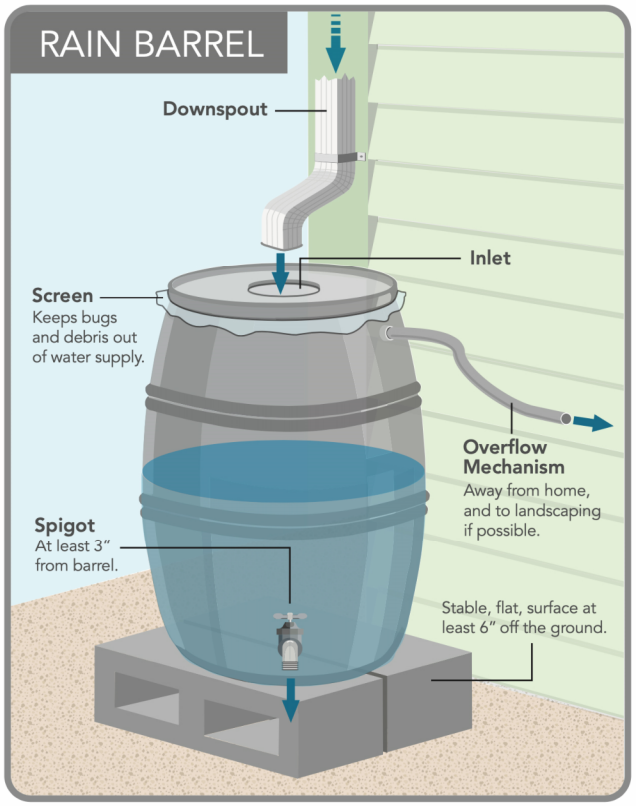
- **As needed** – empty rain barrel within (24) hours of rainstorm
- **Weekly** – Debris removal, Visual Inspection of Inlets & Outlets
- **Twice a year** – Inspect barrel screen for signs of wear or deterioration and repair / replace as needed. Check gutters and downspouts are secured to building.
- **Annually** – Clean and disinfect cisterns/rain barrels.

Cost/Implementation Challenges

- Low cost
- Capturing runoff from surfaces other than rooftops requires treatment prior to storage.
- Effective implementation requires reliable and constant demand for non-potable water use.
- Mechanical components require regular maintenance.

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: Medium
- Addresses Volume: Medium. Dependent on size. Residential vs Industrial 100 up to 100,000 gallons in capacity



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Stormwater Planter Box

Description

- Small contained vegetated area that collets and treats stormwater using bioretention.
- Do not require a large amount of space and can add aesthetic appeal.

O&M Acceptance

- **Weekly –** Debris removal, watering & weeding during establishment, visual inspection of inlets and outlets.
- **Monthly** – Weeding
- **Annually** – Mulching, regrading eroded areas, pipe and outlet inspection and clean out, replacing plants as needed

Cost/Implementation Challenges

- Medium costs
- Maintenance costs will vary depending on the size and material of the planter and the types of plants utilized.

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: Medium
- Addresses Volume: Low. Dependent on size.

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Rain Garden

Description

- Shallow depression designed to collect rain from impervious surfaces such as roofs, streets, patios, and driveways.
- Reduce rain runoff by allowing stormwater to soak directly into the ground, instead of flowing into storm drains.

O&M Acceptance

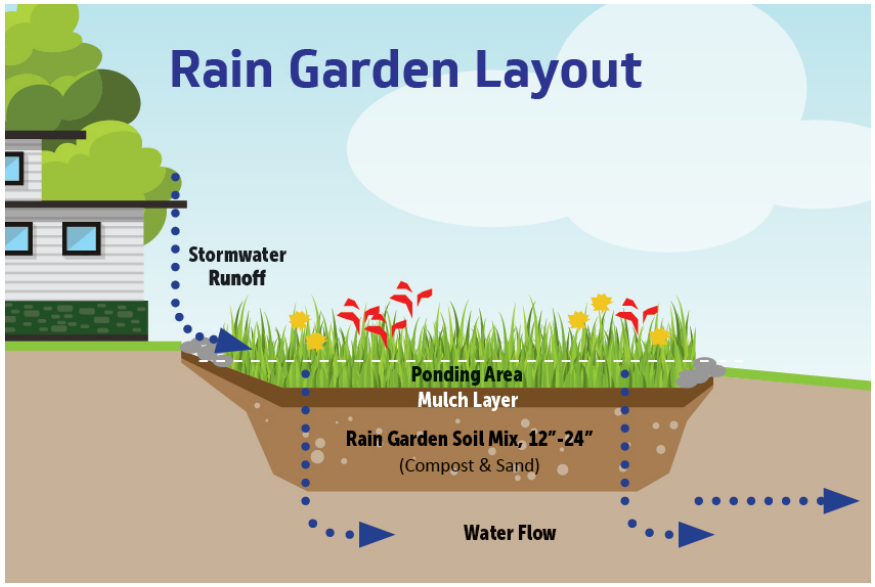
- **Weekly** – Debris removal, Visual Inspection of Inlets & Outlets, Watering & weeding during establishment
- **Monthly** – Weeding
- **Annually** – Mulching. Regrade eroded areas. Pipe and outlet inspection and clean out. Replacing plants as needed

Cost/Implementation Challenges

- Cost dependent on space requirements, design, construction
- Installation must be away from large trees to avoid tree root rot and 10-15 ft away from structure foundations and "down slope" to avoid water draining back

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: High
- Addresses Volume: Medium



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Vegetated Roof

Description

- Roof that is partially or completely covered with plants/vegetation. Captures water when it rains and releasing it through evaporation and plant use.
- Reduces rainwater and can help reduce building energy usage and noise levels while increasing the durability and lifespan of the roof compared to conventional roofs.

O&M Acceptance

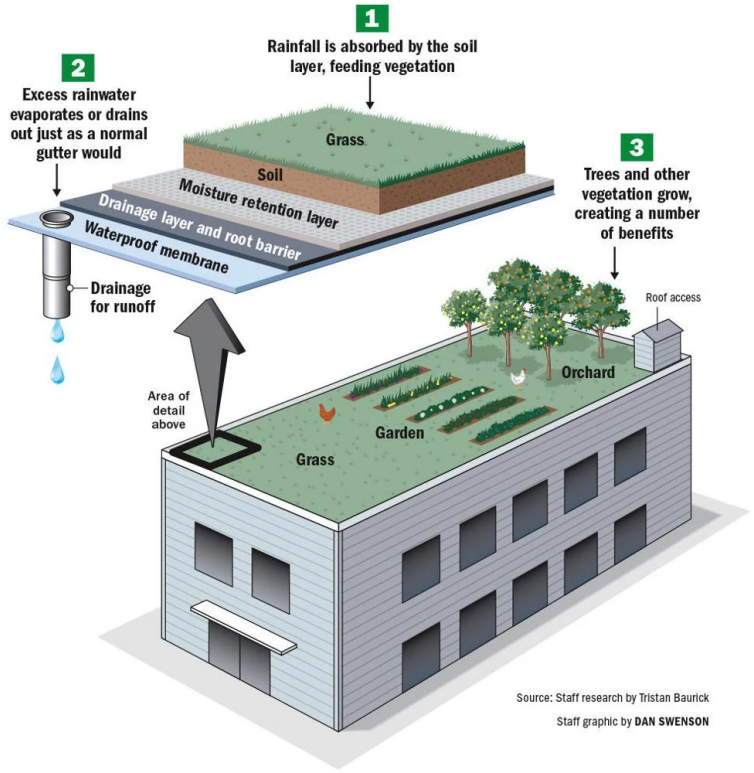
- **As needed** – Water to promote plant growth and survival
- **Semi-annually** – Remove trash/debris, invasive plants, any dead or dying plants, excess debris, fallen leaves and overgrowth
- **Semi-annually** – Inspect waterproof membrane for leaks and cracks and repair any damage
- **Semi-annually** – Inspect and remove overgrowth and debris from roof drains, scuppers and gutters
- **Semi-annually** – Inspect plant composition for consistency with approved plans and correct any deficiencies
- **Semi-annually** – Check and repair areas of erosion

Cost/Implementation Challenges

- High costs compared to conventional roof
- Roof must be able to support added load from roof and designed capacity.

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: Low
- Addresses Volume: Low. Higher water quality benefits than quantity



https://www.epa.gov/soakuptherain/soak-rain-green-roofs

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Tree Planting

Description

- Helps to reduce rain runoff by absorbing water.

O&M Acceptance

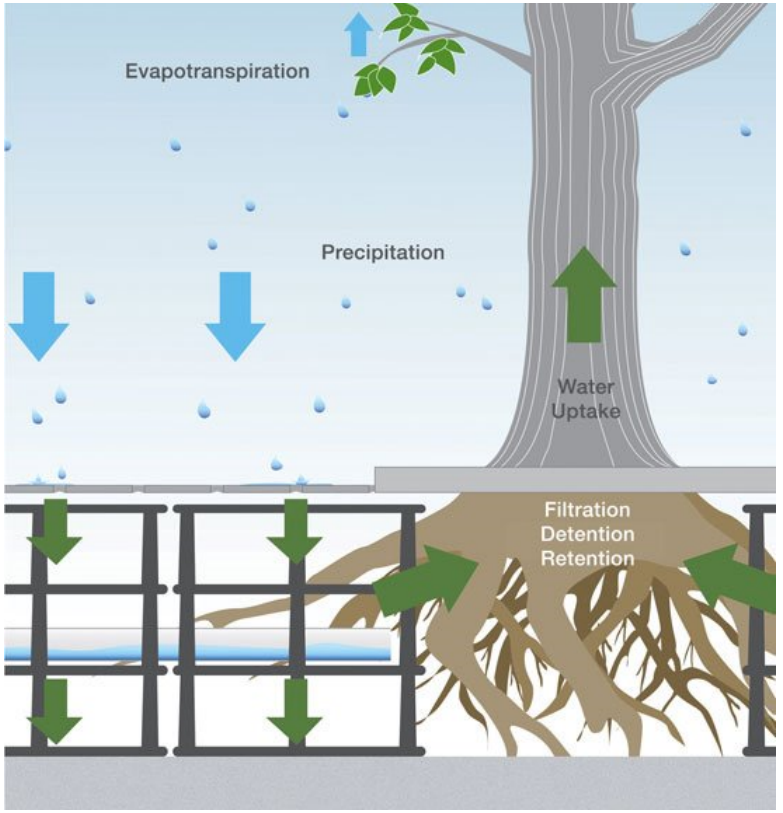
- **Weekly (for first year)** – Fill Water Bags
- **Monthly** – Weeding
- **Annually** - Mulching, Elevate lower limbs and remove dead, rubbing, or crossing limbs

Cost/Implementation Challenges

- Low cost
- Spacing for root system needs to be considered
- Native Species required

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: Medium
- Addresses Volume: 1 mature bald cypress tree can absorb over 500 gallons/day



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Tree Box

Description

- Captures water from the downspout of a building or canopy.
- Water is filtered through layers of mulch, soil, rock, and plants before it soaks into the ground
- Can connect to an existing downspout and do not need a large amount of space. Planters can include native grasses, flowers, shrubbery, or trees.

O&M Acceptance

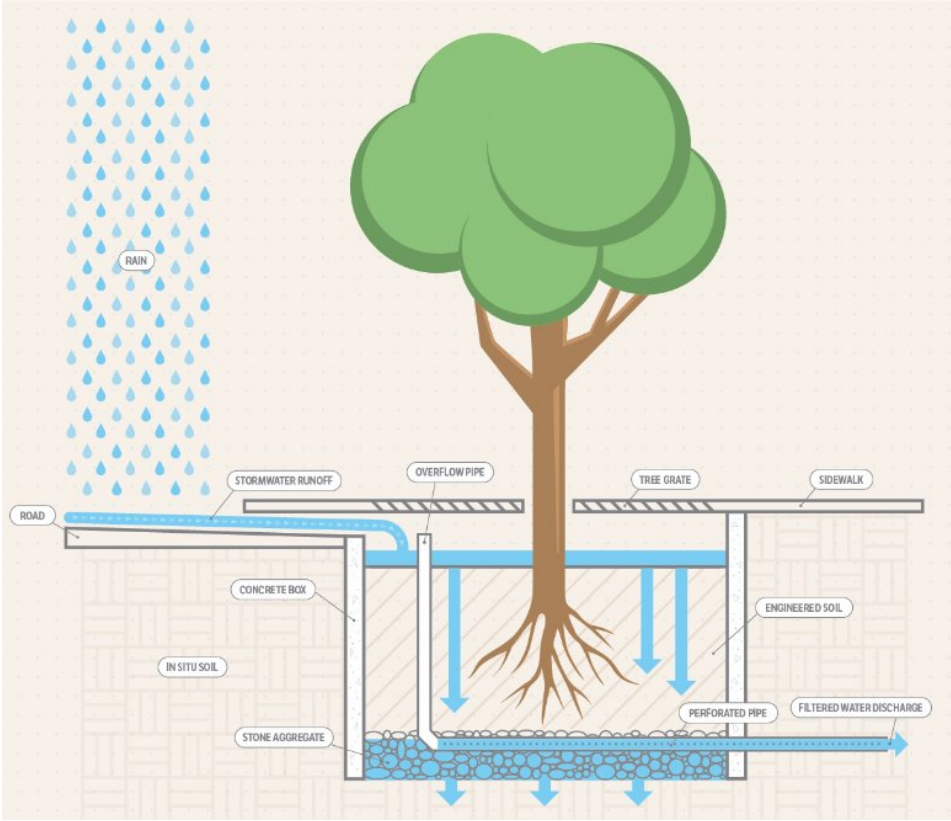
- **Monthly** – Inspect for evidence of clogging, standing water, accumulation of sediment, debris/trash, inlet & outlet structure inspection for evidence of accumulation of sediment, debris/trash
- **As needed** – weeds presented
- **Yearly** – mulch layer less than 3" deep: needs additional mulch

Cost/Implementation Challenges

- Final tests and inspections of the tree box filter's function conclude the installation procedure.
- Depending on the location and area of coverage, installation can cost between $17,000 and $88,160*

Additional Factors

- Suitable for Flood Prone Areas: Yes
- Community Buy-in: Medium
- Addresses Volume: Low storage



* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl

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Curb Stormwater Planter Box

Description

- Stormwater infiltration cells constructed to treat and manage stormwater runoff from the street.
- Water is temporarily stored.
- Can be installed anywhere in ROW
- Typically walled vertical sides with a flat bottom area.

O&M Acceptance

- **Weekly –** Debris removal, watering & weeding during establishment, visual inspection of inlets and outlets.
- **Monthly** – Weeding
- **Annually** – Mulching, regrading eroded areas, pipe and outlet inspection and clean out, replacing plants as needed

Cost/Implementation Challenges

- Medium costs
- Maintenance costs will vary depending on the size and material of the planter and the types of plants utilized.

Additional Factors

- Suitable for Flood Prone Areas: Medium
- Community Buy-in: Medium - High
- Addresses Volume: Low, dependent on size.

https://water.phila.gov/development/stormwater-plan-review/manual/

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Tree Trench

Description

- System of trees connected by an underground infiltration structure.
- Stormwater runoff flows through a special inlet leading to the stormwater tree trench. The runoff is stored in the empty spaces between the stones, watering the trees and infiltrating through the bottom.

O&M Acceptance

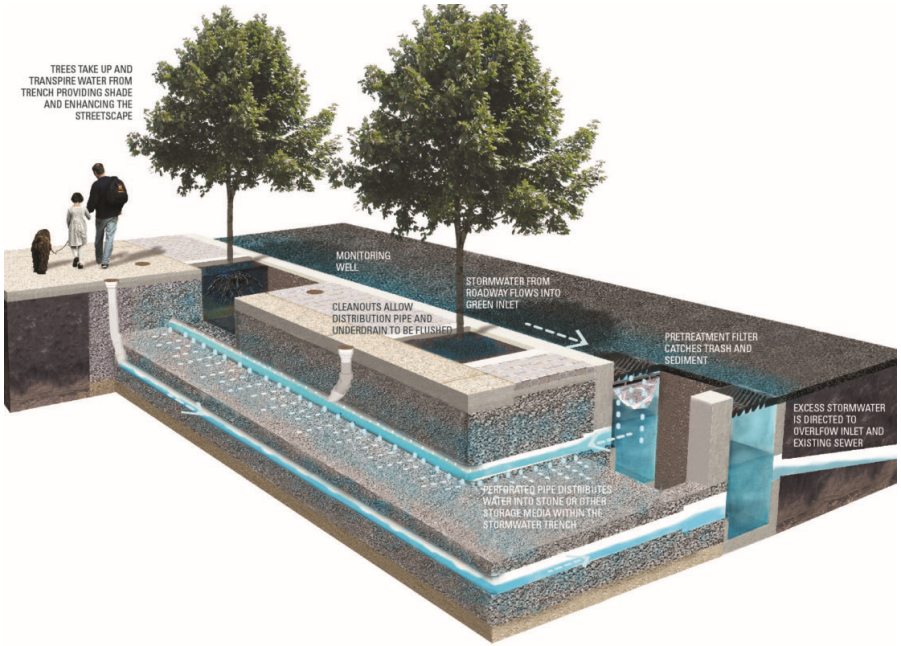
- **Weekly** – Supplemental watering during drier periods. Particularly if keeping stormwater offline trees are established.
- **Twice after storm events > 0.5 in.** Check for ponding within trenches and for evidence of clogging in the media
- **As needed** – remove weeds, remove any trash or debris, add mulch layer if layer is less than 3 inches, remove stakes
- **Annually** – Clean root collar
- **Biannually and after large storms** – Inspection of tree health

Cost/Implementation Challenges

- Low cost
- Spacing for root system needs to be considered
- Native Species required

Additional Factors

- Suitable for Flood Prone Areas: Low
- Community Buy-in: Medium - High
- Addresses Volume: Low storage volume



https://water.phila.gov/development/stormwater-plan-review/manual/

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Bioretention

Description

- Shallow depression designed to collect rain from impervious surfaces such as roofs, streets, patios, and driveways.
- Usually have overflow structure such as weir or drainpipe

O&M Acceptance

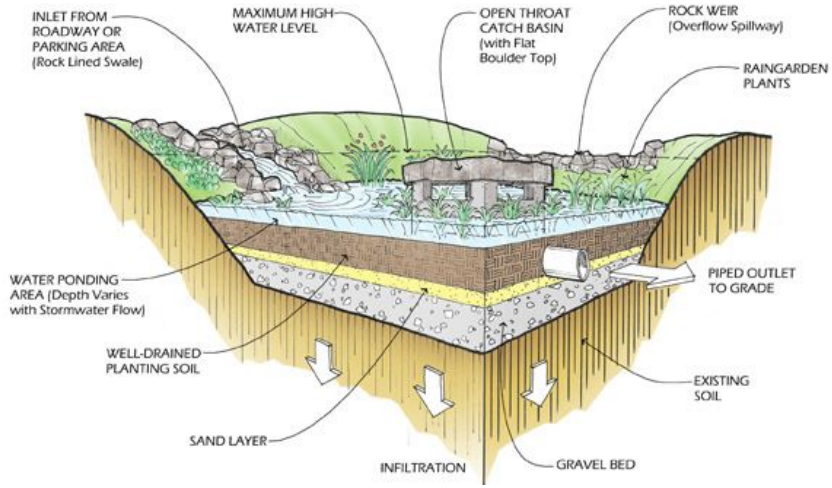
- **1-2 times/yr** – Pruning
- **2-12 times/yr** – Mowing
- **2-3 days** - watering for first 1 – 2 months; sporadically after establishment
- **Monthly –** inlet/outlet inspection after first rain of the season, then monthly during rainy season
- Replacement of top few inches of filter media if ponding occurs for more than 48 hours.

Cost/Implementation Challenges

- Costs can range from $61K to $245K per acre of impervious surface treated.
- Smaller systems being more expensive per acre.

Additional Factors

- Suitable for Flood Prone Areas: Yes
- Community Buy-in: High
- Addresses Volume: Medium Storage; Higher water quality benefits. Design will have to be adjusted to increase water quantity



* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl

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Vegetated Bioswale

Description

- Modified swales that use vegetation and an engineered media to beneath the swale to improve water quality, reduce runoff volume, and modulate peak runoff rate.
- Share similarities to bioretention and rain garden but are linear

O&M Acceptance

- **Annual (semiannual the first year) -** inspect pretreatment areas, grass along slopes for erosion and formation of rills/gullies. Remove accumulated trash and debris. Inspect and correct erosion problems in the sand/soil bed. Evaluate vegetation health
- **As needed**- cultivate surface if ponded water does not draw down within 48 hours. Remove sediment buildup if accumulation reaches 25% of the original design volume
- **Seasonally** – mow grass to maintain a height of 3-4 inches.

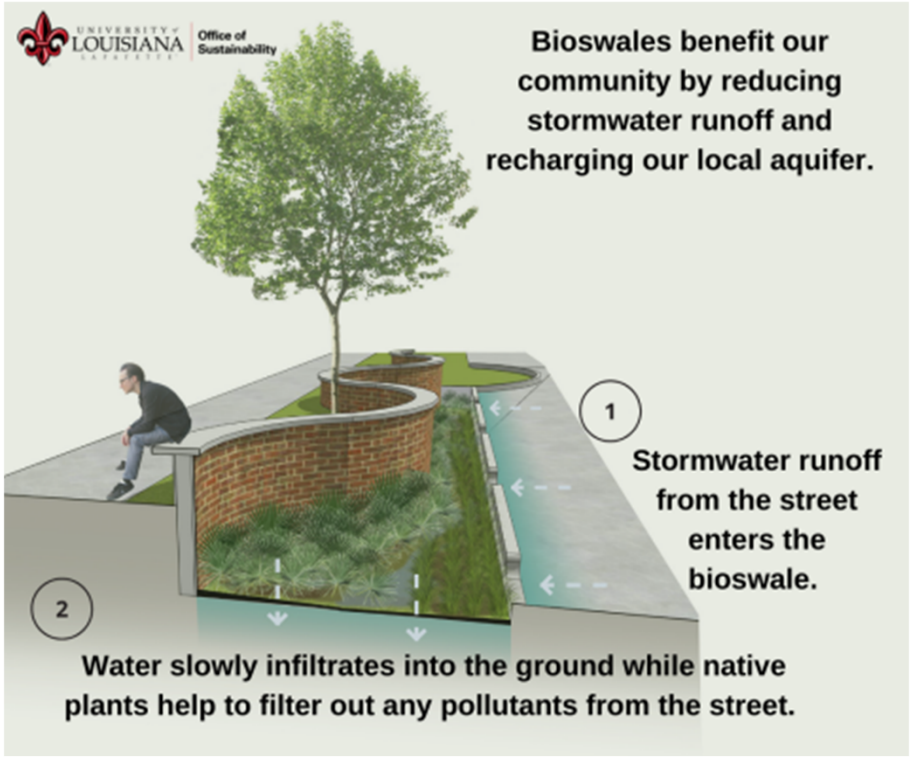
Cost/Implementation Challenges

- Approximately $35,500 to $71,000* per acre of impervious surface treated.
- Maintenance is critical to both designed flow capacity and pollutant removal

Additional Factors

- Suitable for Flood Prone Areas: Yes
- Community Buy-in: Medium
- Addresses Volume: Low storage, design will need to be adjusted to increase storage. Bioswale has higher water quality benefits

* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl



https://sustainability.louisiana.edu/why-we-love-green-infrastructure-and-native-plants/272

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Permeable Pavement

Description

- Solid interlocking paving units made of fired clay or concrete. Water flows through the joints between the individual pavers. The joints are filled with small rocks or stones that still provide space for stormwater to flow.
- Can be used instead of concrete, for walking paths, patios, or driveways.

O&M Acceptance

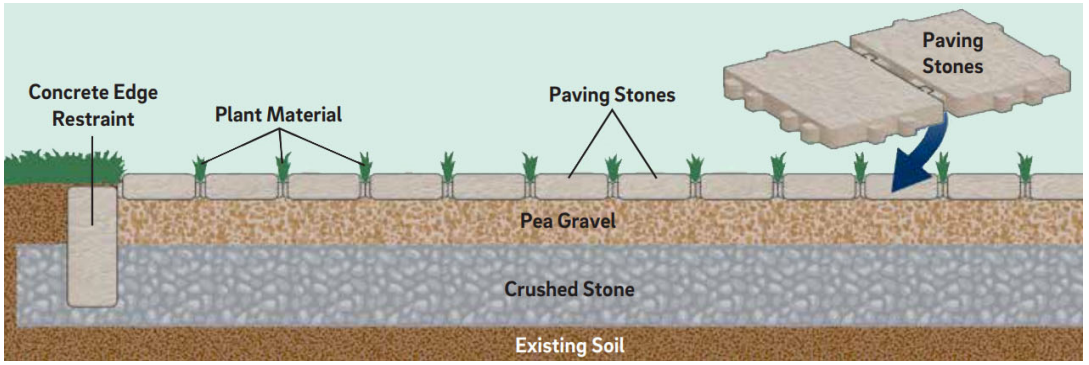
- **Every other week**- Debris removal, visual inspection of inlets & outlets
- **Every other month** – Spot pressure washing
- **Annually** – replace joint fill material

Cost/Implementation Challenges

- High costs compared to traditional pavement to construct initially, savings are in maintenance and stormwater management costs.
- Construction costs range from $1.4 to $2 per square foot for porous asphalt, $4 to $12 per square foot for pervious concrete and $9 to $19 per square foot for PICP (VDEQ, 2013)*

Additional Factors

- Suitable for Flood Prone Areas: Yes
- Community Buy-in: Medium
- Addresses Volume: Medium storage



https://ready.nola.gov/green-infrastructure/

* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl

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Infiltration Trench

Description

- Long shallow trench filled with draining rock or crushed stone.
- Runoff is stored in void space between stones & infiltrates through the bottom and into the soil matrix.

O&M Acceptance

- Frequent maintenance in urbanized areas, where they can become clogged with trash and debris.
- Soils on site must be appropriate for infiltration - Potential for groundwater contamination
- **Monthly** = Debris removal, Weeding, Visual Inspection of Inlets & Outlets
- **Annually** = Regrade eroded areas, pipe and outlet inspection and cleanout
- **As needed** = Washing of the top layer of aggregate

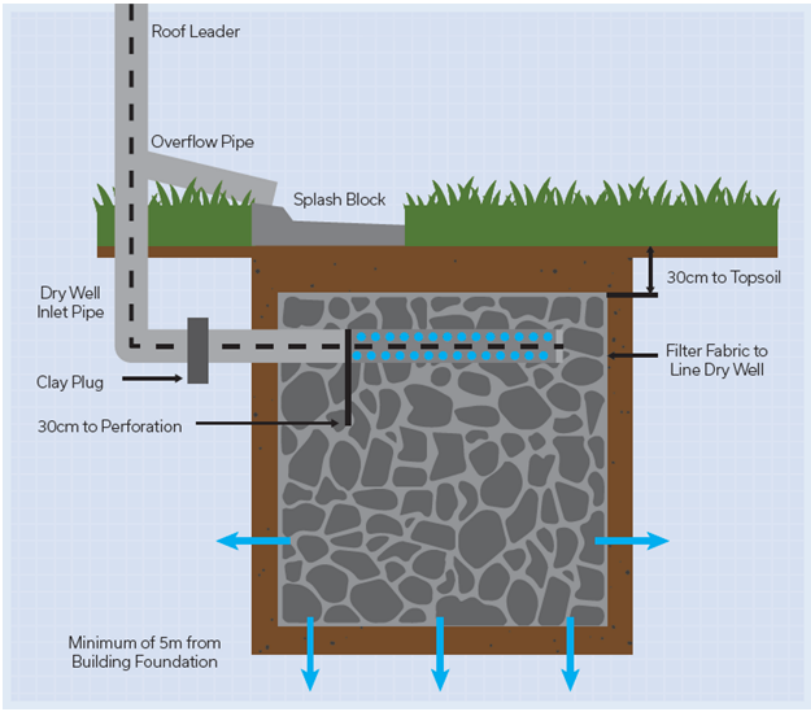
Cost/Implementation Challenges

- Approx. $84K to $98K per acre of impervious surface*
- If improperly maintained, infiltration trenches have a high failure rate.

Additional Factors

- Suitable for Flood Prone Areas: Yes – avoid discharge from contaminated stormwater discharges
- Community Buy-in: Medium
- Addresses Volume: Medium

* Prices updated to 2024 per https://data.bls.gov/cgi-bin/cpicalc.pl



https://ready.nola.gov/green-infrastructure/

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Subsurface Infiltration Chamber

Description

- Underground holding areas that receive and store stormwater from impervious areas. Detained stormwater slowly infiltrates through the bottom and sides of the system into the surrounding sub-soil.

O&M Acceptance

- Pre-treatment options are recommended to facilitate maintenance and reduce risk of failure from debris & sediment.
- Routine – inspection and cleaning trash, debris, and sediment from pre-treatment devices
- Half yearly – cleaning trash, debris from inlets and outlets or when pre-treatment device sump is half full

Cost/Implementation Challenges

- High installation cost
- Infiltration basins are generally not appropriate for dense urban areas largely due to space requirements
- Potential of infiltrated water to interfere with existing infrastructure.

Additional Factors

- Suitable for Flood Prone Areas: High
- Community Buy-in: Medium
- Addresses Volume: High

https://water.phila.gov/development/stormwater-plan-review/manual/

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Appendix D. BGSI Feasibility Input

GSI	Type	Location	Suitable for Flood Prone Areas	Addresses Volume	O&M Acceptance	Implementation Challenges	Community Buy-in
Detention Basin	Blue	Surface	This is a good solution for areas like Jefferson Parish or NOLA East where there is more open space.		Does require more maintenance than underground storage	Doing stuff under city owned land	Tax buy-ins and fees reductions for insentives
						For dense urban areas, this is a difficult solution to implement.	This is a toss up, some residents like open detention basins while other residents don't. Using trees and aesthetic vegetation helps with buy in.
						consider price of land	City Park was previously rejected
							How will this impact shortage of affordable housing?
Floodable Spaces	Blue	Surface	Alleyways are a good floodable space				Favor underground systems.
			Great idea as long as these spaces are maintained properly.				Need things that can live on the hot days, but thrive in the days with flood
							Might not be great to market as a water solution, but can be messaged as a landscaping solution
							Tying green and gray together
							Consider in vacant lots
							Passive parks. No programming
							Concderns on mosquitos, community is more concerned but City has better understanding
							potential for community confusion if spaces flood frequently... need consistent education.
							consider minimize the footprint of the floodable area with a bioswale - make the water less seen & slow down water
							Need to grow the level of the trust with the city
							NIMBY mentality
							Need to consider the demographics of neighborhoods chosen for this - are there a lot of parks, multi-family housing, lack of yards? will we be taking away the only recreation areas after rain events?
							Retrofitting currently high ground - lack community buy in
							Lake Vista lanes are walking paths
Floodable Street	Blue	Surface	The streets already flood here		This would require a adequate O&M plan to clear streets of debris after large flood events.		Need to consider the sized of the ROW
					Would missed maintenance cause flooding levels that could impact cars or homes? If there is that risk, can we accept that as a City?		Ensure community education
							Residents would have a hard time accepting this a long-term solution unless more trust in pump system is created.
							Investment that people have put into their lawn

GSI	Type	Location	Suitable for Flood Prone Areas	Addresses Volume	O&M Acceptance	Implementation Challenges	Community Buy-in
Detention Vault	Blue	Subsurface	Can retain water when pump systems are surcharged	Volume is dependent on outfall depth and surface area	Trash screens available for quality		Communities like this solution because they can be used under parks
				SWBNO doesn't pump down all canal	Low cost maintenance		community buy in - adopt a catch basin for an organization to clean out the detention vault to take away from the manpower needed from maintenance
					City has gotten more value out of dention basins than any other BMP - oak park/broadmoor; using water quality system		Currently not a type of dention preferred boradmoor - contract picked system with shortest lead time - let the contractor farm out the type;
Box Culvert Street	Blue	Subsurface			Does anyone remember the car in the Lafitte canal?	Utility conflicts	Easy buy-in since there are plenty of streets with box culverts
					How is debris removed from these		Will implementation lead to road repair and road stability? If so, could be a big win for some neighborhoods.
Downspout Disconnection	Green	Parcel-Based					
Rain Barrel/Cistern	Green	Parcel-Based					CAP program under SGI - Gentilly area only - highlighted and marketed well; other areas have been asked and questions; Arc Council painted rain barrels - highly asked for (150)
							CAP has great lessons learned
							Visibility provides positive peer pressure for neighborhoods. Increases local impact.
							homeowner took some of the cost based on the brackets
Stormwater Planter Box	Green	Parcel-Based					
Rain Garden	Green	Parcel-Based					
Vegetated Roof	Green	Parcel-Based	Great solution for zero lot lines and downtown areas.	Not a great volume solution	High maintenance and irrigation cost regardless of how drought tolerant	Lack of maintenance enforcement from City	Rooftops don't have to be fully vegetated for community buy-in. They can be large planters or rooftop trees.
Tree Planting	Green	Surface					
Tree Box	Green	Surface		The soil voids in the tree cells can be used for storage.	Little to no maintenance	Very expensive	Tree cells allow urban canopy in densely paved urban areas. Can also help trees become more resilient to hurricanes.
Curb Stormwater Planter Box	Green	Surface			If maintenance is done properly, they are a good solution. Community engagement is necessary so residents don't remove plants or fill it with trash.	Each neighborhood presents different design challenges.	Good solution as long as it doesn't take up street parking. Can help with traffic calming
Tree Trench	Green	Surface					
Bioretention	Green	Surface		Help with small rain events, but bioretention isn't a great flood mitigation solution unless it's on a large scale.	Great tool if maintenance is regular. If these systems go unmaintained, they lose value.	Most neighborhoods have a narrow ROW, which require retaining walls. But work great in areas with larger ROWs.	Residents usually love this GI solution.
						Great solution for dense urban areas that need less pavement.	
					Grass swales are easier to maintain, but are less effective at pollutant removal		Conflict with parking

GSI	Type	Location	Suitable for Flood Prone Areas	Addresses Volume	O&M Acceptance	Implementation Challenges	Community Buy-in
Vegetated Bioswale	Green	Surface			If catching street run off in ROW, maintenance needs to be adopted like many neutral ground areas in Lakeview		
Permeable Pavement	Green	Subsurface	Can help with areas that have ponding water in streets and near curb inlets	PP can be combined with underground storage for flood mitigation	Expensive to maintain and often neglected. Peformance can decrease by 50% in first year.	Precast concrete is working but cast in place has a lot of failures	Most residents like PP, especially pavers.
					No entity to maintain	One of the most expensive BMPs for GI.	Failure of PP in Jefferson Paver due to clogging caused community concerns
						Not enough qualified contractors	Current code is that permeable pavement is required.
Infiltration Trench	Green	Subsurface			As long as pretreatment is used, maintenance can be low-cost	Finding soils that can infiltrate is difficult in NOLA	Most residents are used to french drains, so this should get community accpentance
					Better in limited access, non-ruban areas		
Subsurface Infiltration Chamber	Green	Subsurface	Not a good solution for flood mitigation	Storage isn't always availble if groundwater is high	As long as pretreatment is used, maintenance can be low-cost	Finding soils that can infiltrate is difficult in NOLA	Most residents are used to french drains, so this should get community accpentance

Appendix E. Concept Plans

PROJECT NO.	SHEET NO.
DPW724	TITLE OF 27

CITY OF NEW ORLEANS

STATE OF LOUISIANA

DEPARTMENT OF PUBLIC WORKS

PROJECT NO. DPW724/D3791500

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

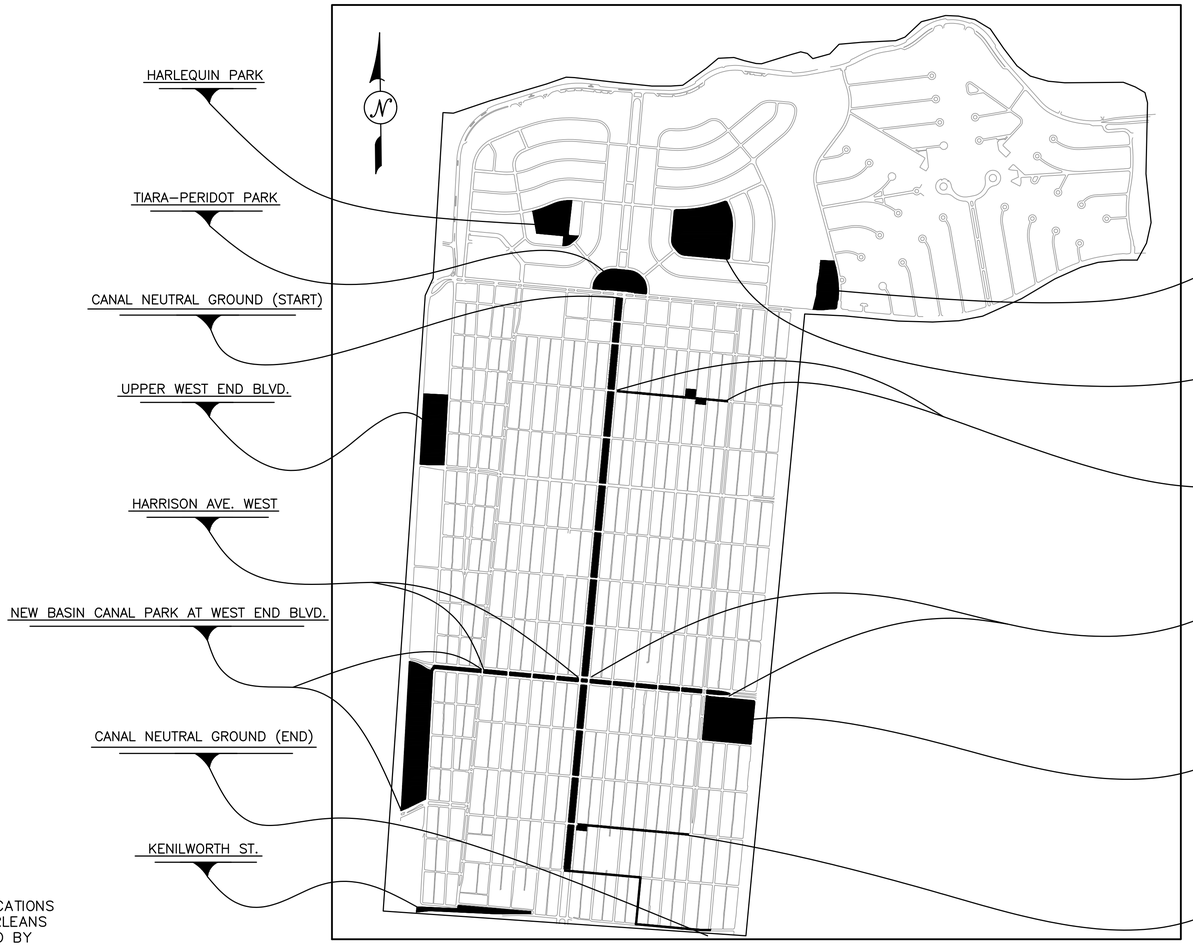
CONCEPTUAL (10%) DESIGN PLANS

PREPARED BY:

JACOBS ENGINEERING GROUP

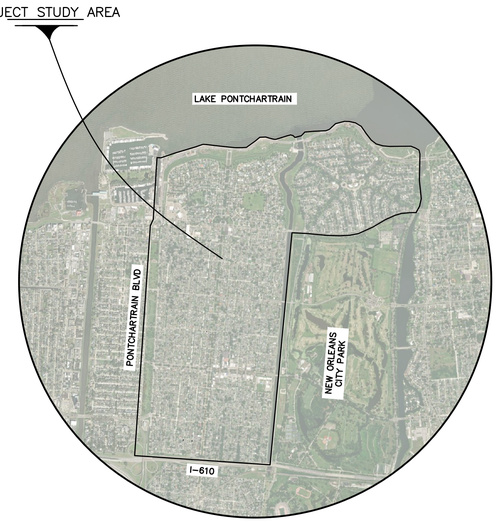
INDEX TO SHEETS

SHEET #	TITLE
COVER	TITLE SHEET
01–02	AREA MAPS
03	001 – HARLEQUIN PARK PLANVIEW
04	002 – TOURMALINE PARK PLANVIEW
05–06	003 – TIARA/PERIDOT PARK PLANVIEW
07	004 – MARCONI LEVEE PLANVIEW
08	005 – UPPER WEST END BLVD PLANVIEW
09	006 – MOUTON ST. PLANVIEW
10	007A– HARRISON AVE WEST PLANVIEW
11	007B– HARRISON AVE EAST PLANVIEW
12	008 – HYNES ELEMENTARY PLANVIEW
13	009 – GERMAIN ST. PLANVIEW
14–21	010 – CANAL BLVD PLANVIEW
22–23	011 – NEW BASIN CANAL PARK PLANVIEW
24	012 – KENILWORTH ST PLANVIEW
25–27	TYPICAL DETAILS
27	TOTAL



LAYOUT MAP

1" = 1000'



VICINITY MAP

NTS

OWNER

CITY OF NEW ORLEANS
DEPARTMENT OF PUBLIC WORKS
1300 POYDRAS STREET, ROOM 6W03
NEW ORLEANS, LOUISIANA 70112
TEL: (504) 658-8000

DESIGN ENGINEER

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115
TEL: (504) 324-2630

CAD DEVELOPMENT

GAEA CONSULTANTS, LLC
536 WASHINGTON AVENUE
NEW ORLEANS, LOUISIANA 70130
TEL: (504) 962-5360

NOTE:

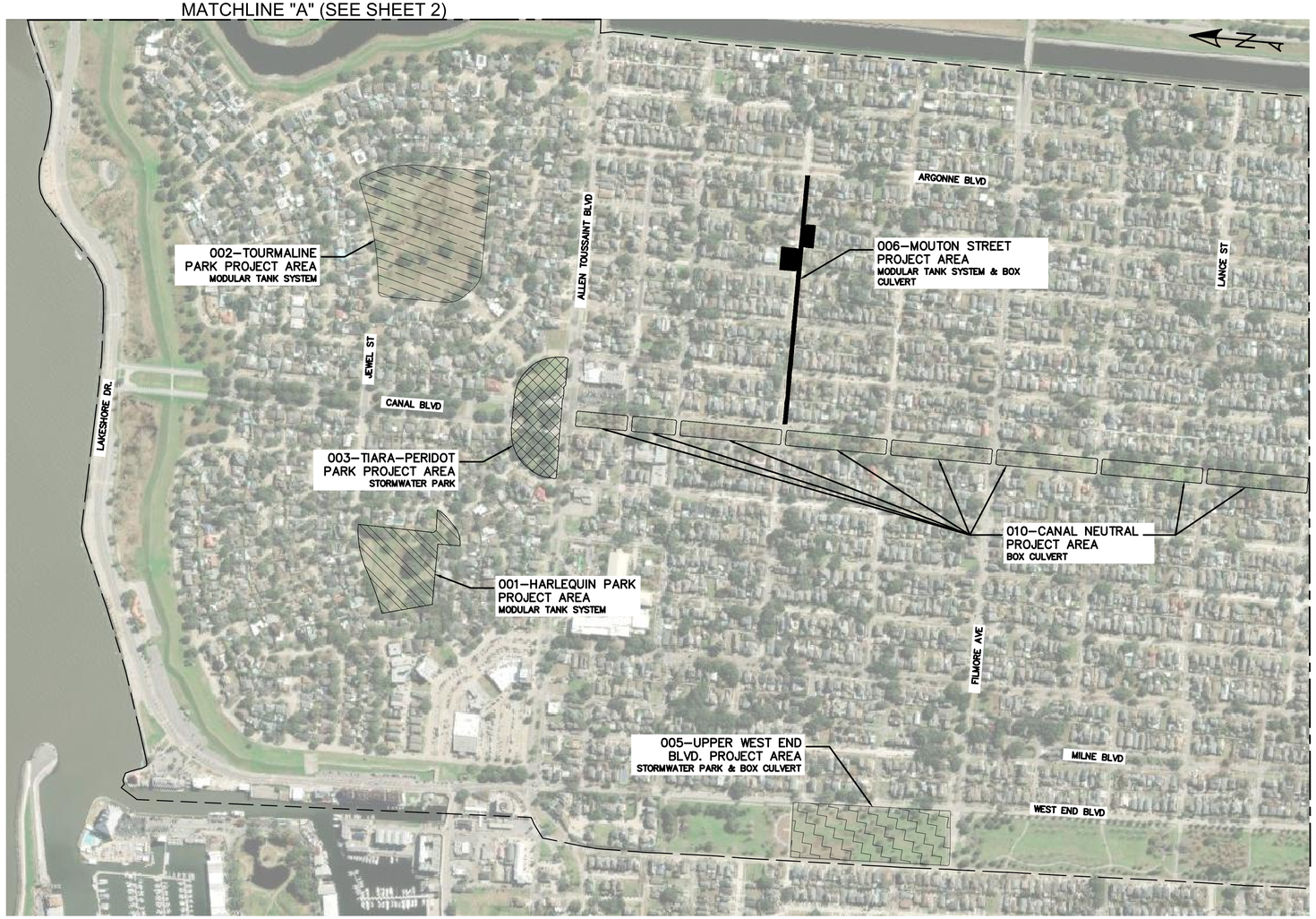
THE DEPARTMENT OF PUBLIC WORKS GENERAL SPECIFICATIONS FOR STREET PAVING, LATEST EDITION, CITY OF NEW ORLEANS SHALL GOVERN ON THIS PROJECT EXCEPT AS AMENDED BY SPECIAL PROVISIONS AND/OR SUPPLEMENTAL SPECIFICATIONS.

DATE: 01–06–2025

PRELIMINARY
10% CONCEPTUAL

PROJECT AREA MAP

MATCHLINE "A" (SEE SHEET 2)



MATCHLINE "B" (SEE SHEET 2)

LEGEND:

- STUDY AREA LIMITS
- 001–HARLEQUIN PARK PROJECT AREA
- 002–TOURMALINE PARK PROJECT AREA
- 003–TIARA–PERIDOT PARK PROJECT AREA
- 004–MARCONI LEVEE PROJECT AREA
- 005–UPPER WEST END BLVD. PROJECT AREA
- 006–MOUTON STREET PROJECT AREA
- 007A–HARRISON AVE. WEST PROJECT AREA
- 007B–HARRISON AVE. EAST PROJECT AREA
- 008–HYNES ELEMENTARY PROJECT AREA
- 009–GERMAIN ST. PROJECT AREA
- 010–CANAL NEUTRAL PROJECT AREA
- 011–WEST END BLVD. PROJECT AREA
- 012–KENILWORTH ST. PROJECT AREA

SCALE : 1" = 500'

0 500 1000 2000

SHEET NUMBER 1

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED
CHECKED	TMK
DETAILED	AED
CHECKED	TMK

SCALE 1"= 500'

DATE JAN. 06, 2025

SHEET 1 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

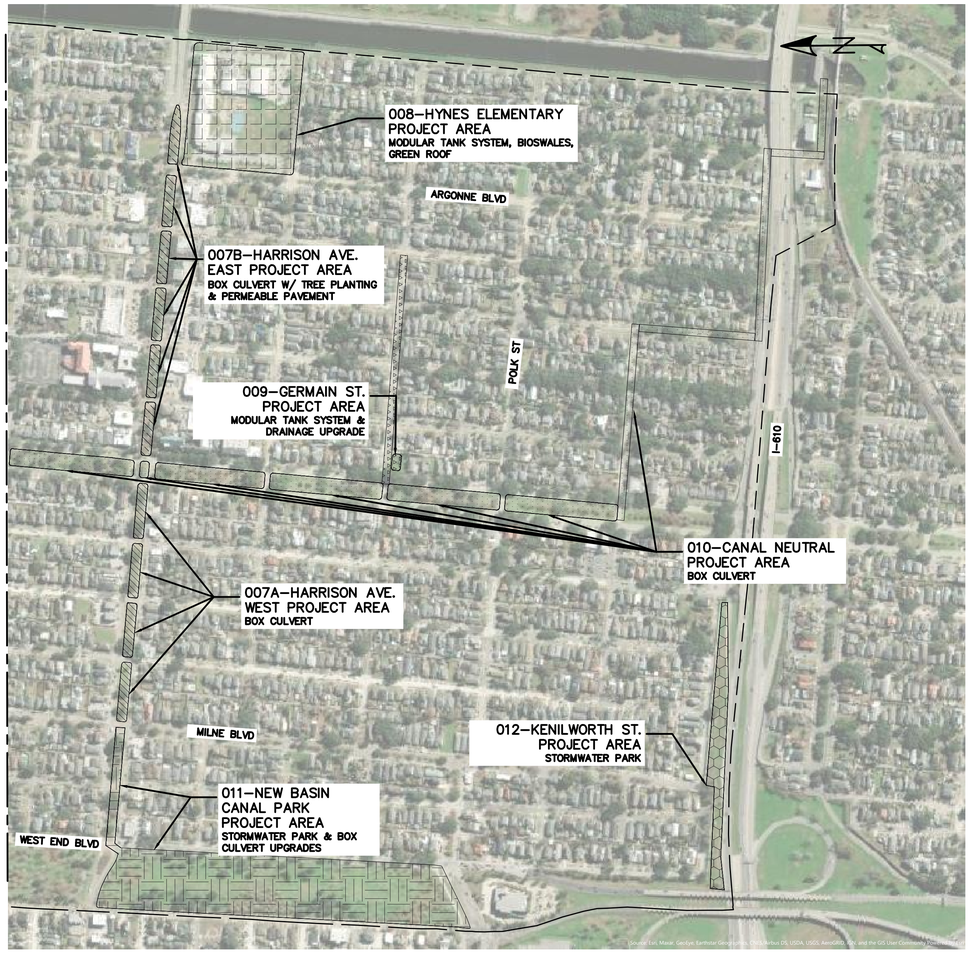
PROJECT AREA MAP

PROJECT AREA MAP (1 OF 2)

PROJECT AREA MAP

MATCHLINE "A" (SEE SHEET 1)

MATCHLINE "B" (SEE SHEET 1)



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- 011–WEST END BLVD. PROJECT AREA
- 012–KENILWORTH ST. PROJECT AREA

SCALE : 1" = 500'

0 500 1000 2000

SHEET NUMBER 2

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1600 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1" = 500'
DATE JAN. 06, 2025
SHEET 2 OF 27

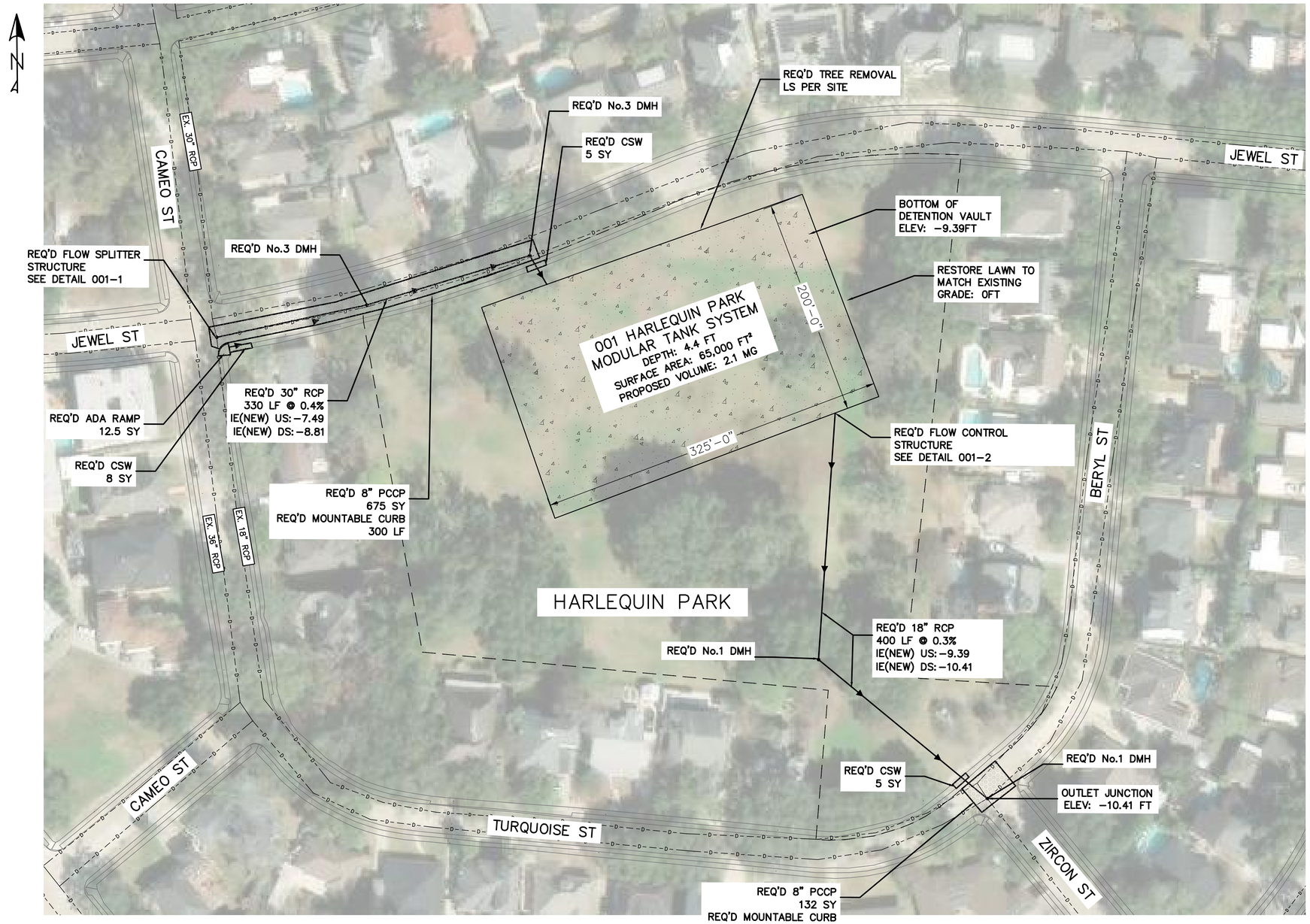
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

PROJECT AREA MAP

PROJECT AREA MAP (2 OF 2)

001–HARLEQUIN PARK PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
2. THIS CONCEPT USES A FLOW SPLITTER STRUCTURE TO DIVERT FLOW AND ROUTE FLOW INTO A SUBSURFACE MODULAR STORAGE SYSTEM. THE OUTLET WOULD BE CONTROLLED USING AN ORIFICE (OR ACTIVE CONTROLS) AND OVERFLOW WEIR/RISER TO HOLD STORMWATER AFTER THE SYSTEM CAPACITY IS RESTORED IN DOWNSTREAM SYSTEM.
3. IT IS RECOMMENDED THAT A FLAP GATE BE INCLUDED DOWNSTREAM OF THE FACILITY TO PREVENT BACKWATER FILLING THE STORAGE VOLUME AND PRESETTLING AND TRASH COLLECTION BE CONSIDERED AS UPSTREAM END OF FACILITY TO EASE MAINTENANCE AND PRESERVE FUNCTION.
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.



LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SCALE : 1" = 50'

0 50 100 200

SHEET NUMBER 3

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555S POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=50' HORIZONTAL
DETAILED AED
CHECKED TMK
DATE JAN. 06, 2025
SHEET 3 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

001–HARLEQUIN PARK PLANVIEW

PLANVIEW (1 OF 25)

002–TOURMALINE PARK PLANVIEW

NOTES:
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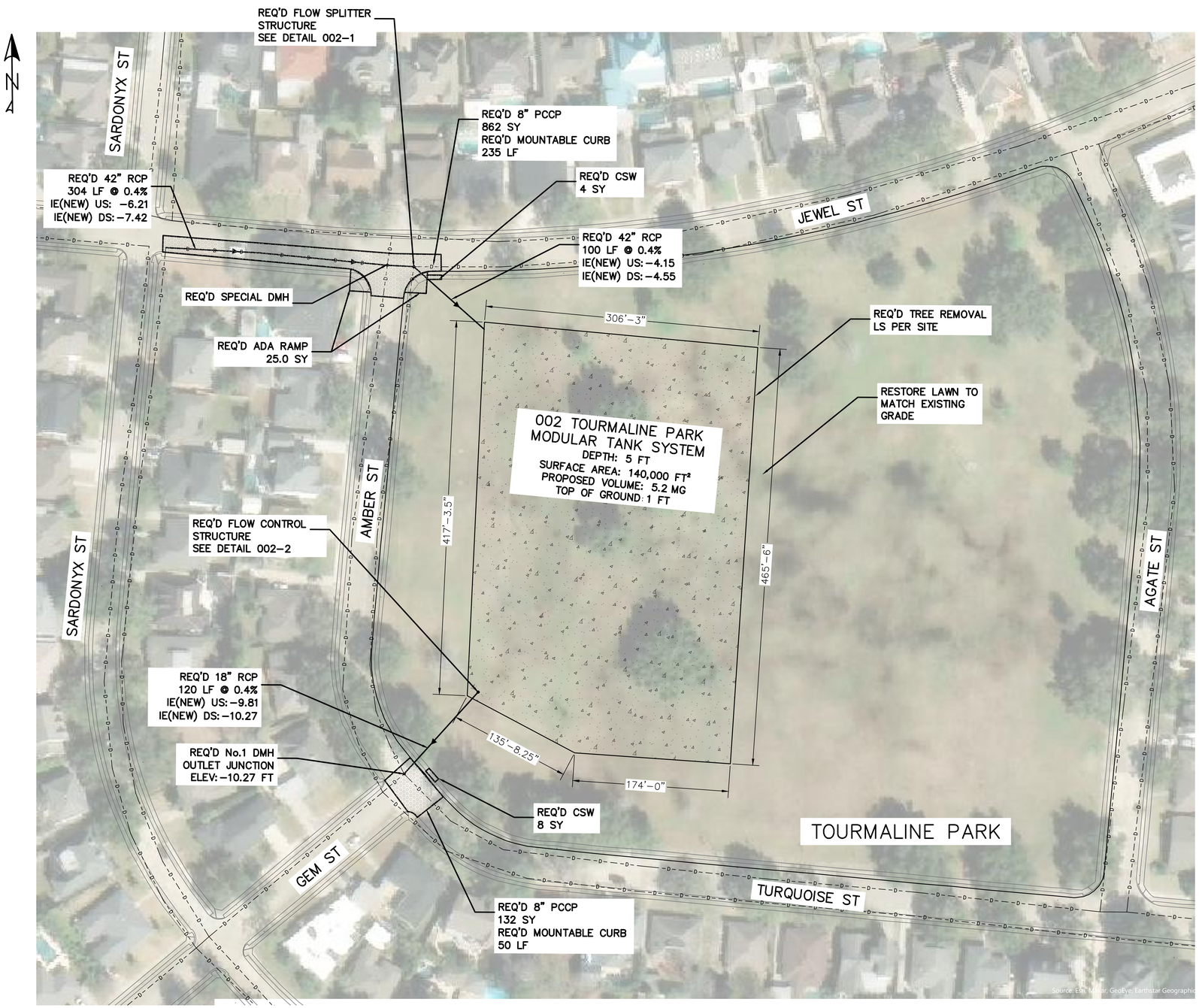

SCALE : 1" = 60'

0 60 120 240

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SHEET NUMBER 4

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED	SCALE	1"=60' HORIZONTAL
CHECKED	TMK		
DETAILED	AED	DATE	JAN. 06, 2025
CHECKED	TMK	SHEET	4 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

002–TOURMALINE PARK PLANVIEW

PLANVIEW (2 OF 25)

003A–TIARA/PERIDOT PARK PLANVIEW

NOTES:
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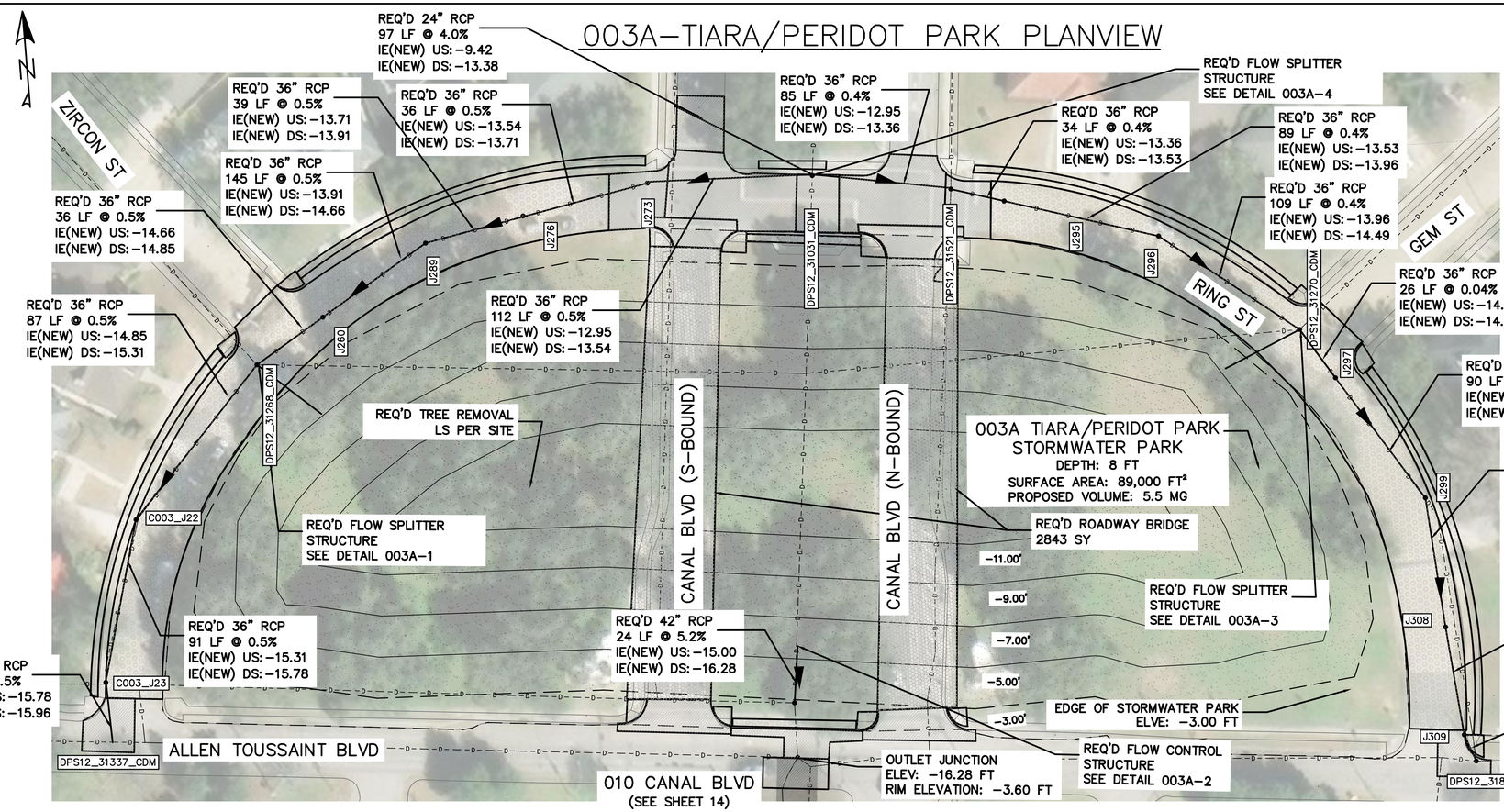
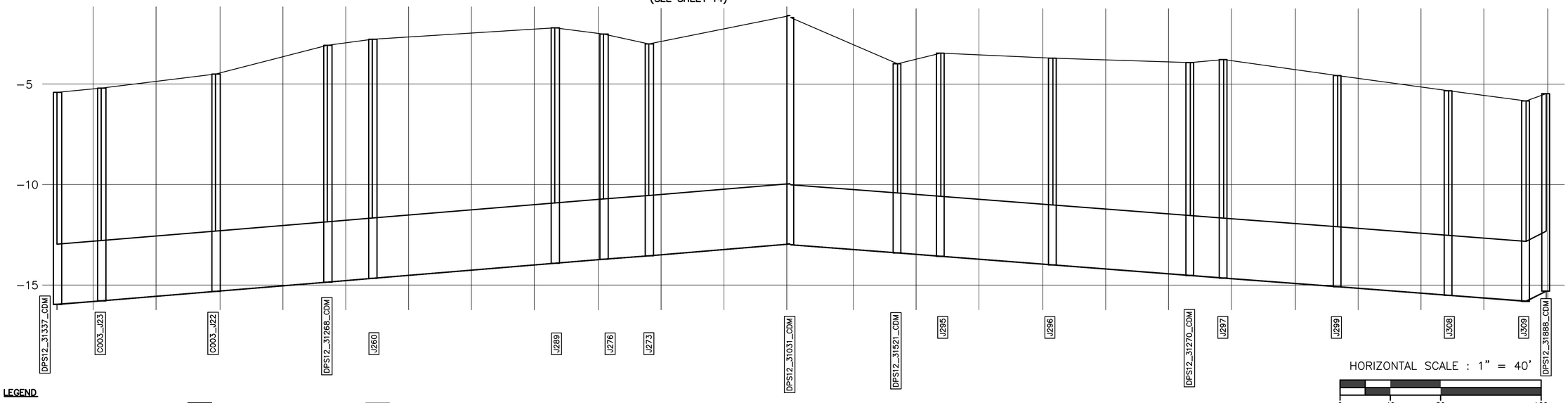


TIARA & PERIDOT PARK:
REQ'D ADA RAMPS
162.5 SY
REQ'D 8" PCCP
4000 SY
REQ'D CSW
450 SY
REQ'D ASPHALT RW
1600 SY
REQ'D BARRIER C&G
210 LF
REQ'D MOUNTABLE CURB
1750 LF
REQ'D 6" DRIVEWAY
150 SY



HORIZONTAL SCALE : 1" = 40'
0 40 80 160

VERTICAL SCALE : 1" = 2.5'
0 2.5 5 10

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SHEET NUMBER 5

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

SCALE: 1"=40' HORIZONTAL, 1"=2.5" VERTICAL
DATE: JAN. 06, 2025
SHEET: 5 OF 27

DESIGNED	AED
CHECKED	TMK
DETAILED	AED
CHECKED	TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

003A–TIARA/PERIDOT PARK PLANVIEW

PLANVIEW (3 OF 25)

003B–TIARA/PERIDOT PARK PLANVIEW

NOTES:
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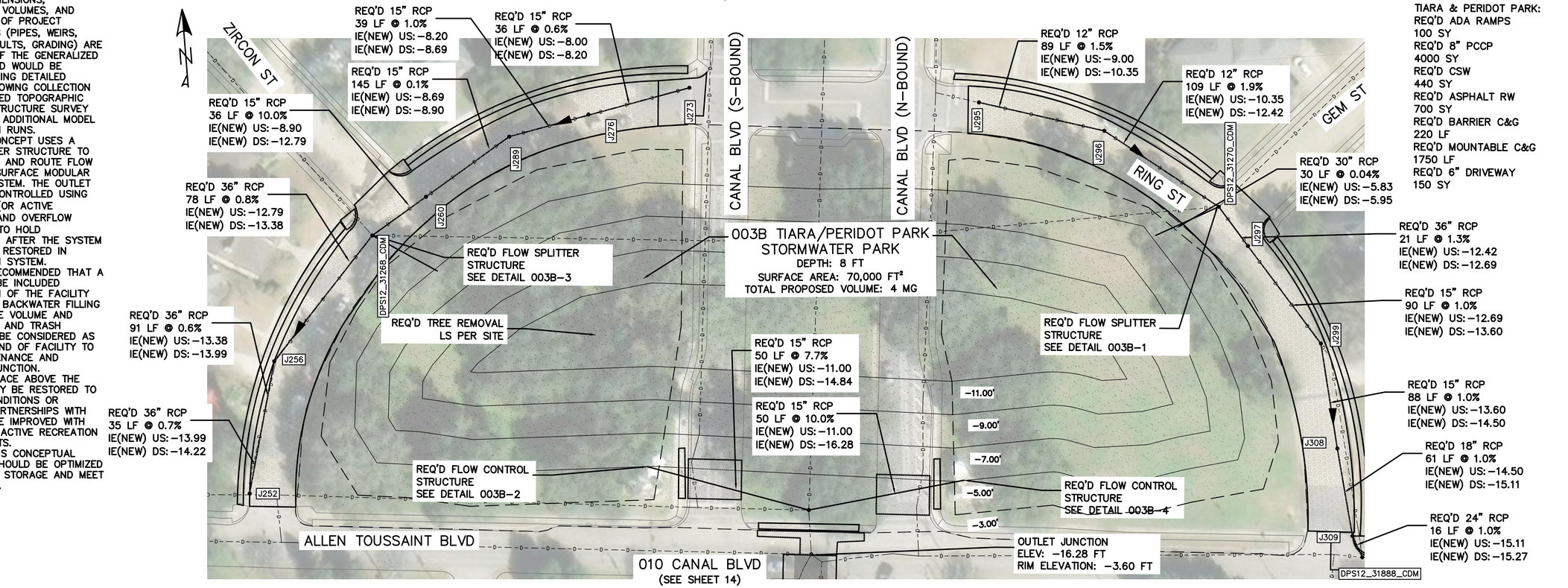
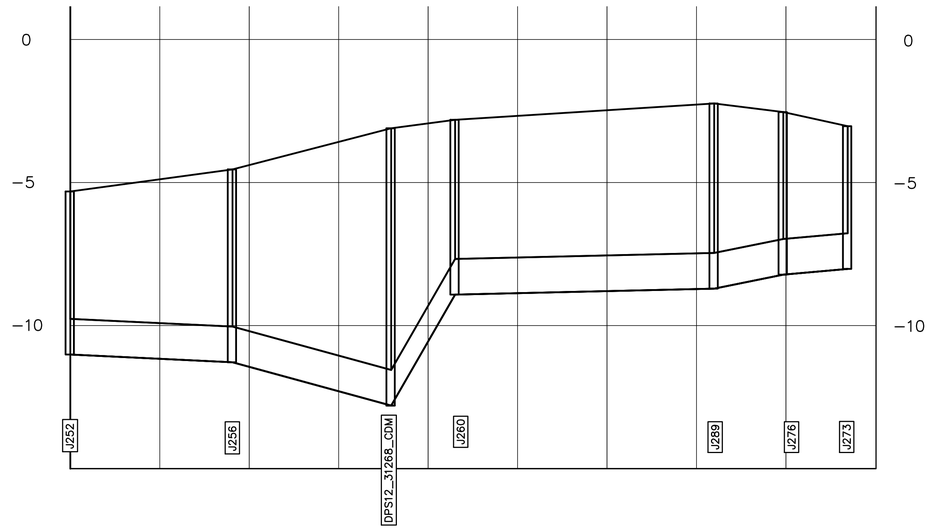
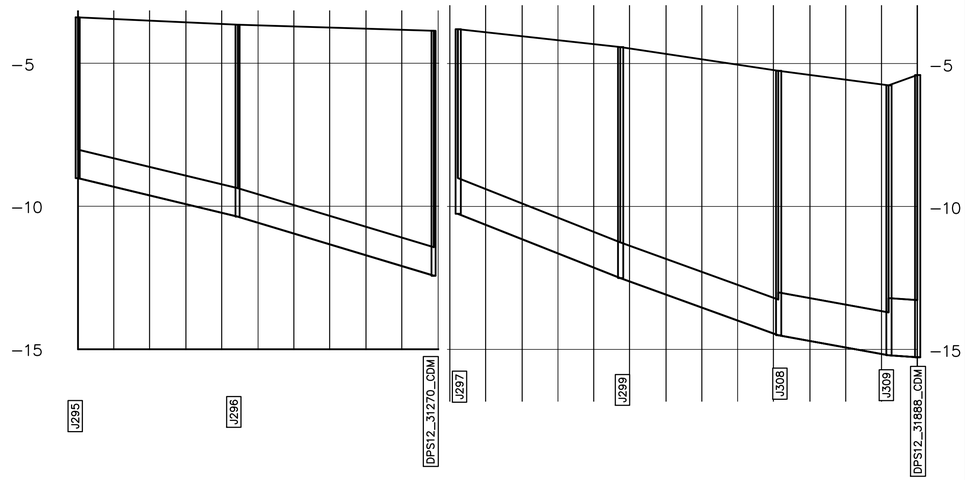


TIARA & PERIDOT PARK:
REQ'D ADA RAMPS
100 SY
REQ'D 8" PCCP
4000 SY
REQ'D CSW
440 SY
REQ'D ASPHALT RW
700 SY
REQ'D BARRIER C&G
220 LF
REQ'D MOUNTABLE C&G
1750 LF
REQ'D 6" DRIVEWAY
150 SY





LEGEND

PROJECT AREA	PERMEABLE PAVERS	OPEN BOX CULVERT	CONDUIT
MODULAR TANK SYSTEM	GREEN ROOF	SUNKEN GARDEN	PORTLAND CEMENT CONCRETE
STORMWATER PARK	BIOSWALE	BOX CULVERT	ASPHALT PAVEMENT
DETENTION BASIN CONTOUR	EXISTING DRAINLINE	JUNCTION	

HORIZONTAL SCALE : 1" = 40'
0 40 80 160
VERTICAL SCALE : 1" = 2.5'
0 2.5 5 10

SHEET NUMBER 6

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=40' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 6 OF 27
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S
003B–TIARA/PERIDOT PARK PLANVIEW
PLANVIEW (4 OF 25)

004–MARCONI LEVEE PLANVIEW

NOTES:
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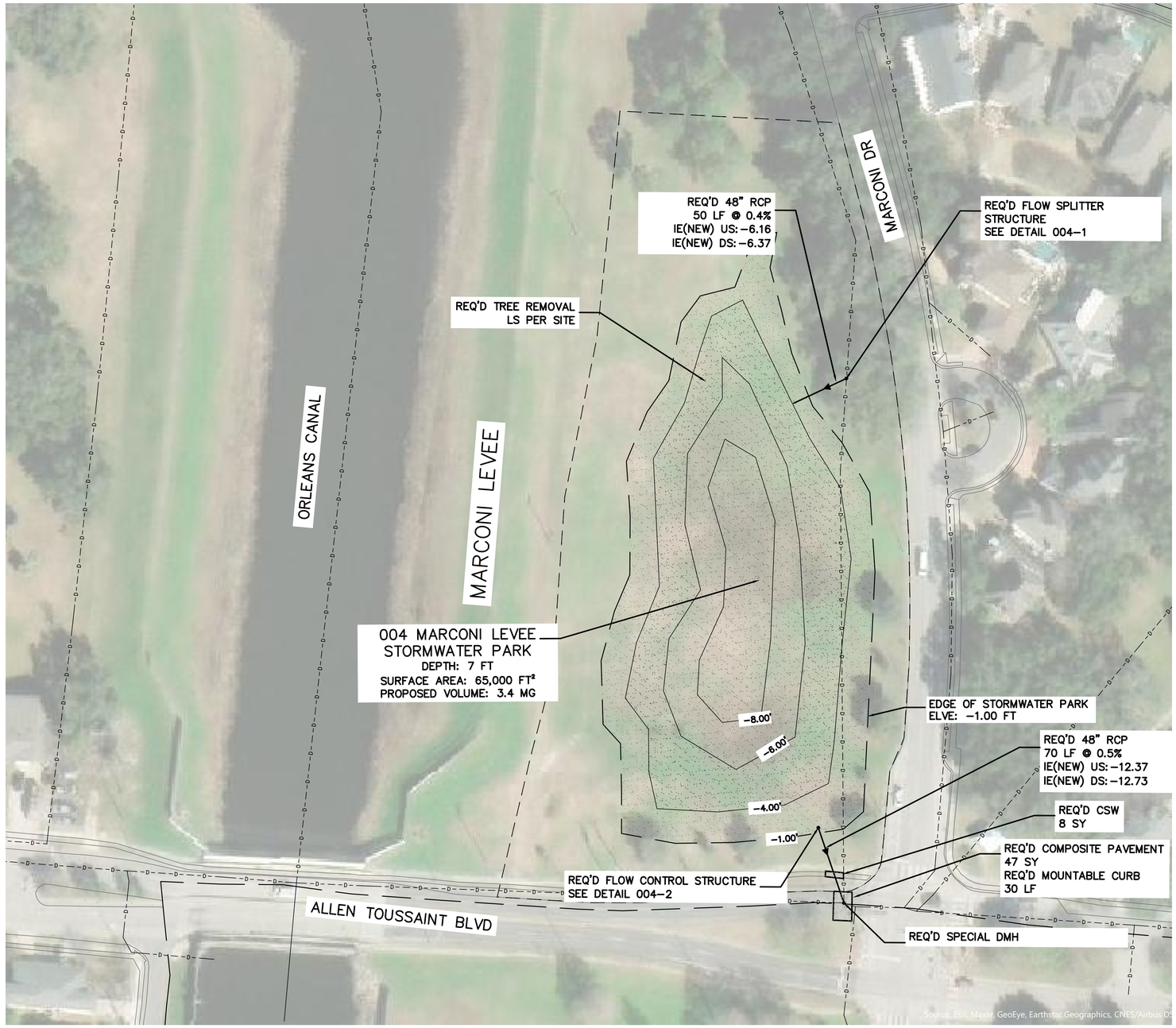

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SCALE : 1" = 50'

0 50 100 200

SHEET NUMBER 7

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555S POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=50' HORIZONTAL
DATE JAN. 06, 2025
SHEET 7 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S
004–MARCONI LEVEE PLANVIEW
PLANVIEW (5 OF 25)

005–UPPER WEST END BLVD PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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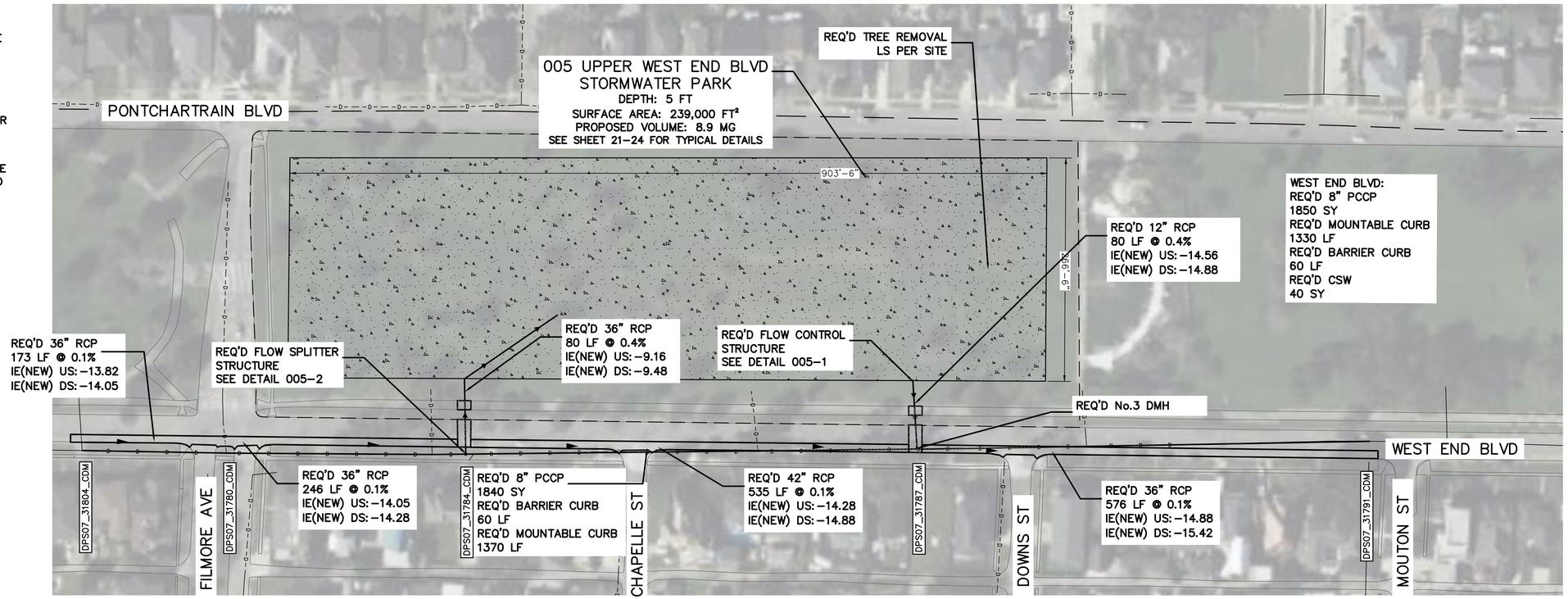

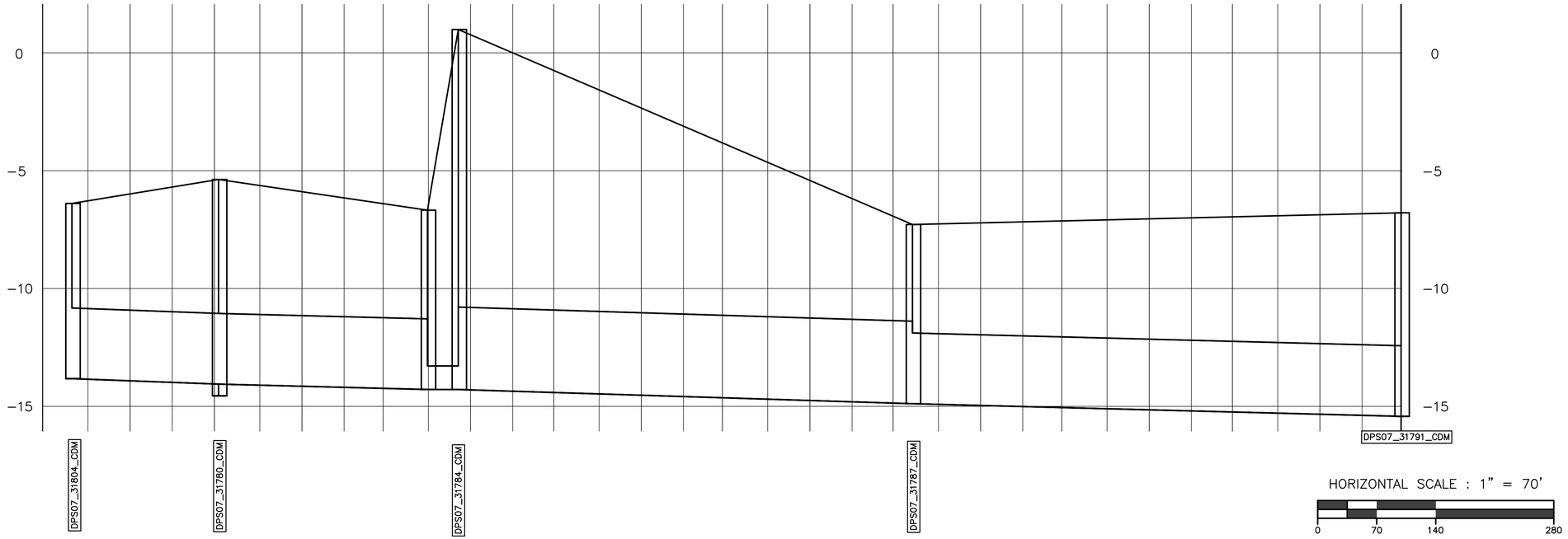

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 70'
0 70 140 280

VERTICAL SCALE : 1" = 2.5'
0 2.5 5 10

SHEET NUMBER 8

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15505 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=70' HORIZONTAL, 1"=2.5' VERTICAL
DETAILED AED
CHECKED TMK
DATE JAN. 06, 2025
SHEET 8 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

005–UPPER WEST END BLVD PLANVIEW

PLANVIEW (6 OF 25)

006–MOUTON STREET PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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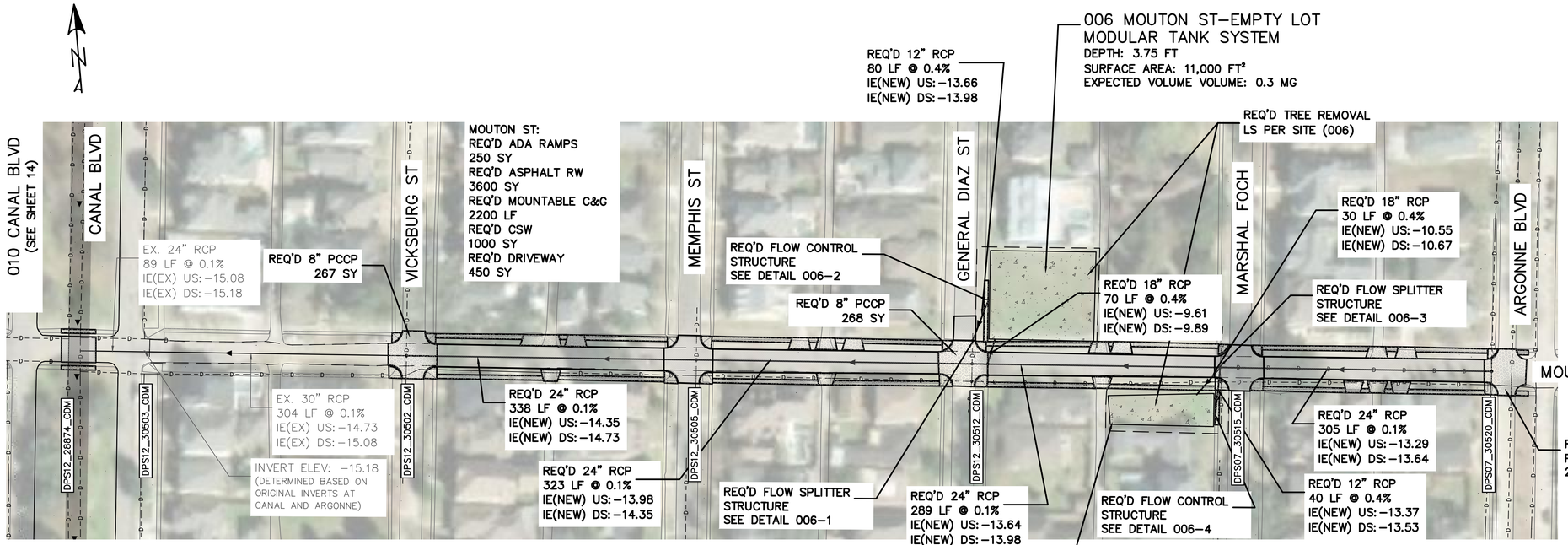

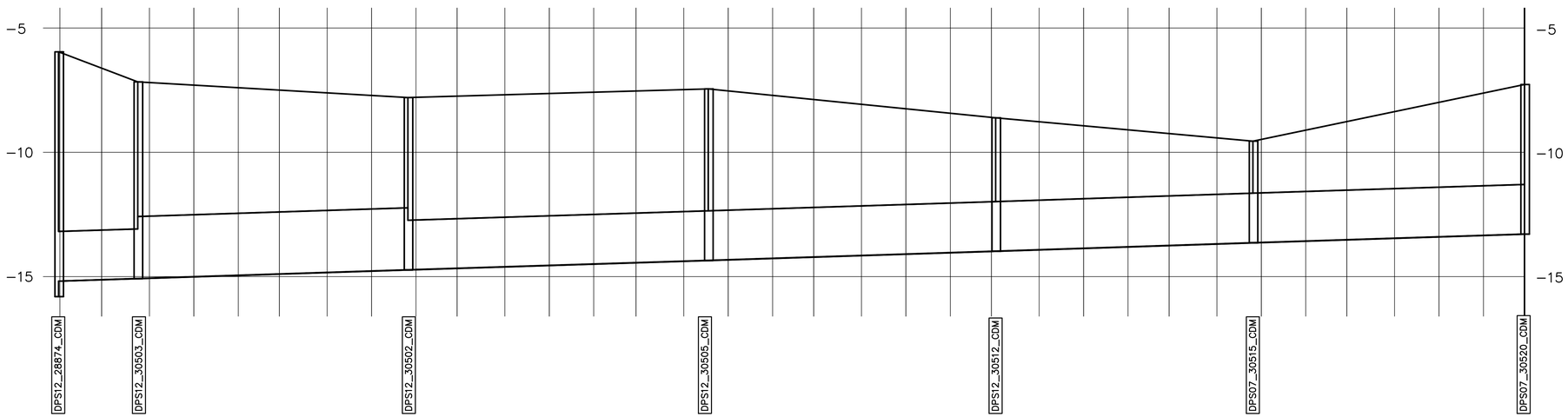

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 70'

0 70 140 280

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 9

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15505 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=70' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 9 OF 27
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

006–MOUTON STREET PLANVIEW

PLANVIEW (7 OF 25)

007A–HARRISON AVE–WEST PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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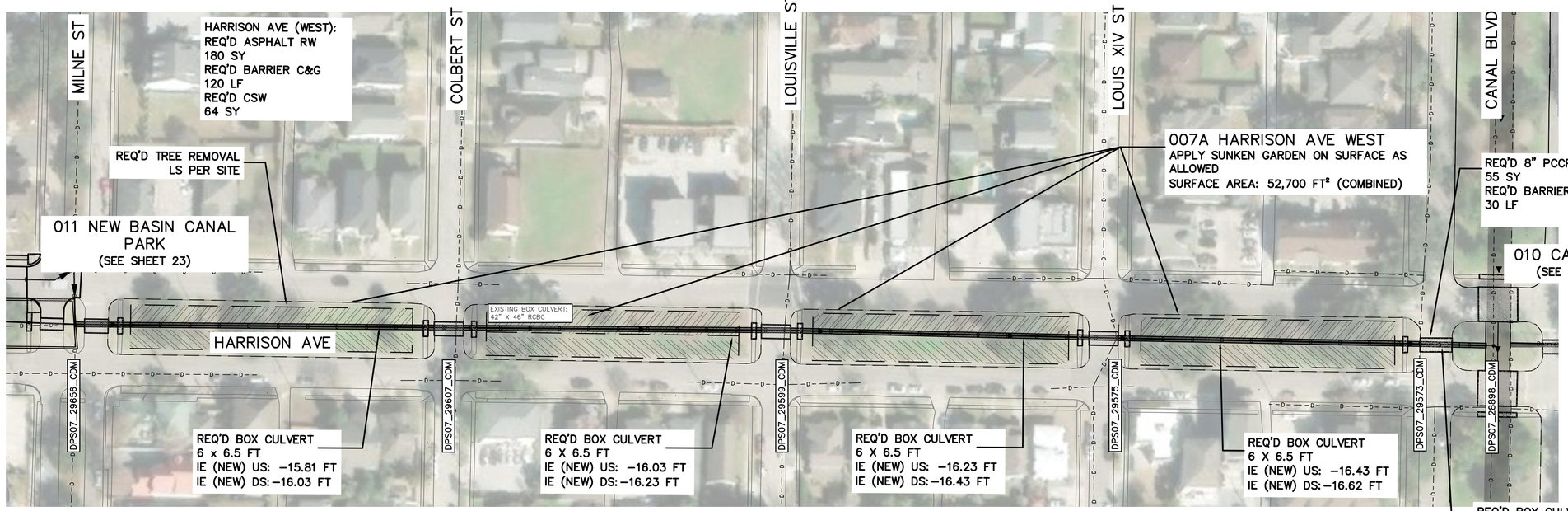

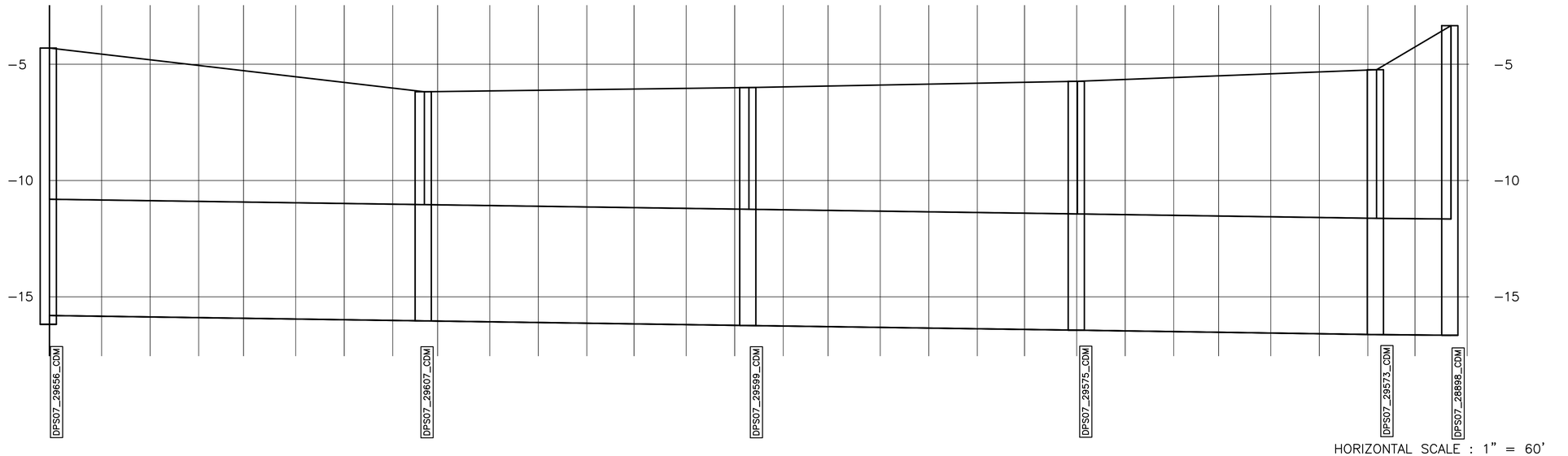

HORIZONTAL SCALE : 1" = 60'

0 60 120 240

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SHEET NUMBER 10

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15595 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK

SCALE 1"=60' HORIZONTAL, 1"=2.5" VERTICAL

DATE JAN. 06, 2025

SHEET 10 OF 27

DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

007A–HARRISON AVE–WEST PLANVIEW

PLANVIEW (8 OF 25)

007B–HARRISON AVE–EAST PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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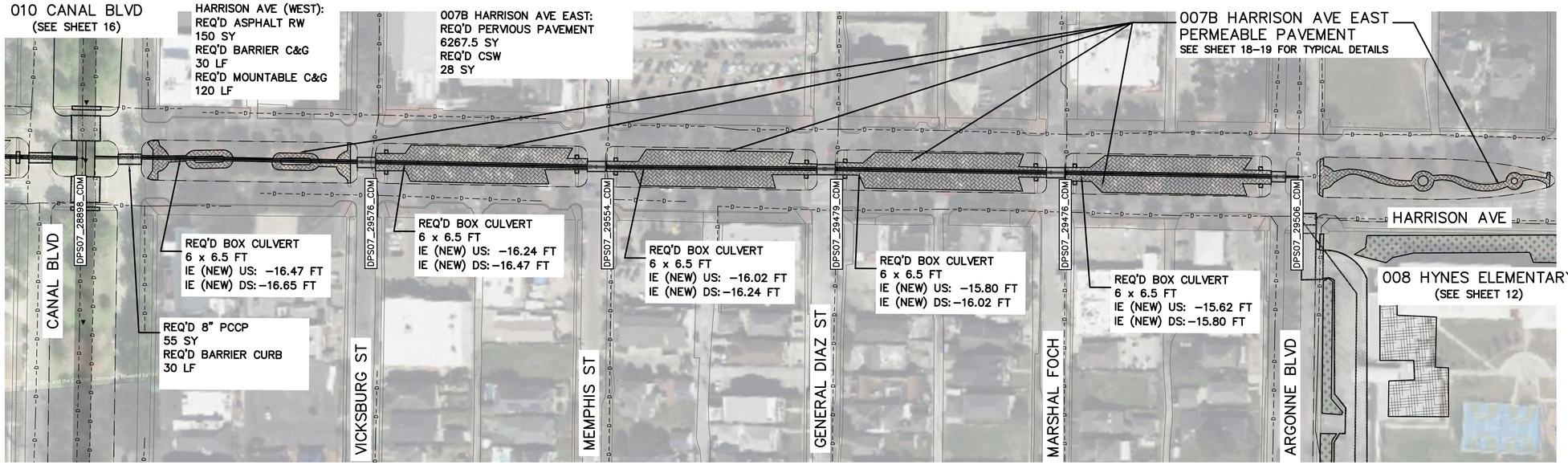

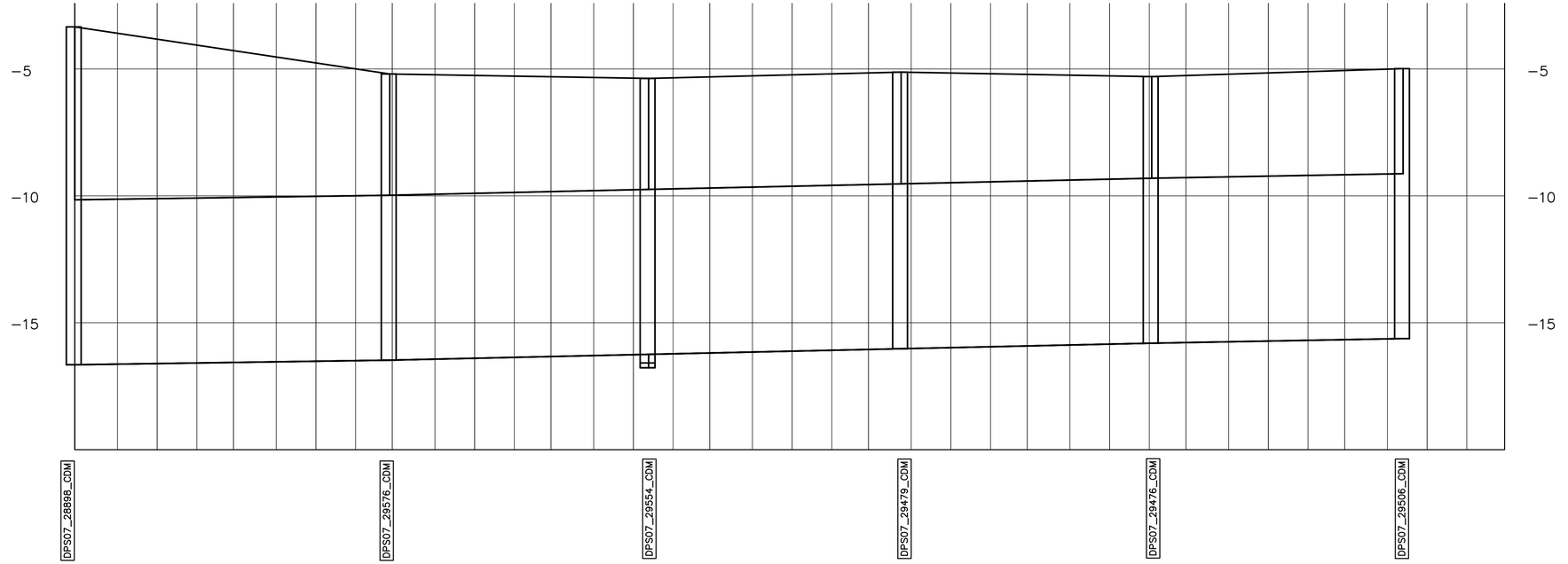

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 80'
0 80 160 320

VERTICAL SCALE : 1" = 2.5'
0 2.5 5 10

SHEET NUMBER 11

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

SCALE 1"=80' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 11 OF 27

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

007B–HARRISON AVE–EAST PLANVIEW

PLANVIEW (9 OF 25)

008–HYNES ELEMENTARY PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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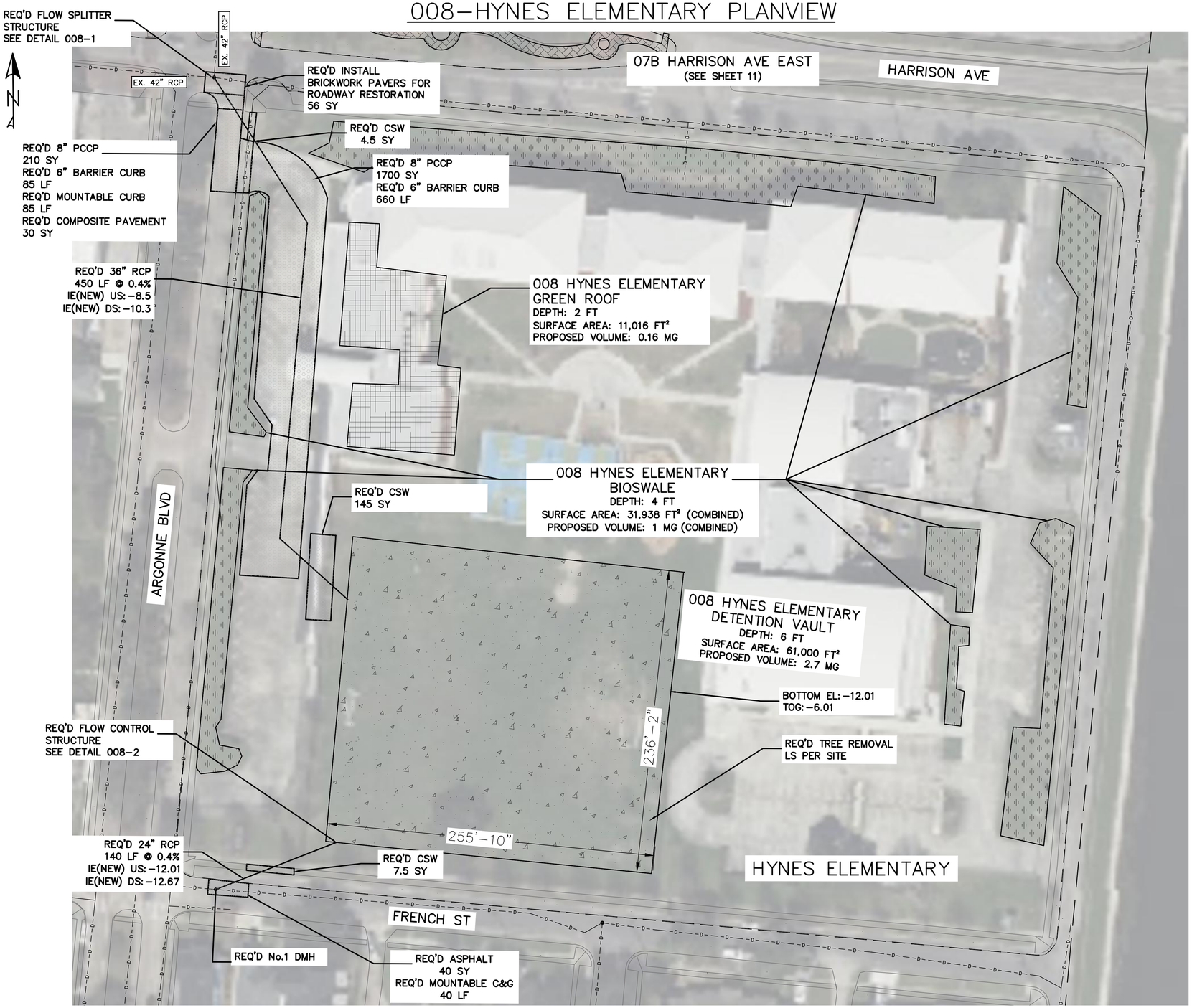

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SCALE : 1" = 40'

0 40 80 160

SHEET NUMBER 12

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=40' HORIZONTAL
DETAILED AED
CHECKED TMK
DATE JAN. 06, 2025
SHEET 12 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

008–HYNES ELEMENTARY PLANVIEW

PLANVIEW (10 OF 25)

009–GERMAIN STREET PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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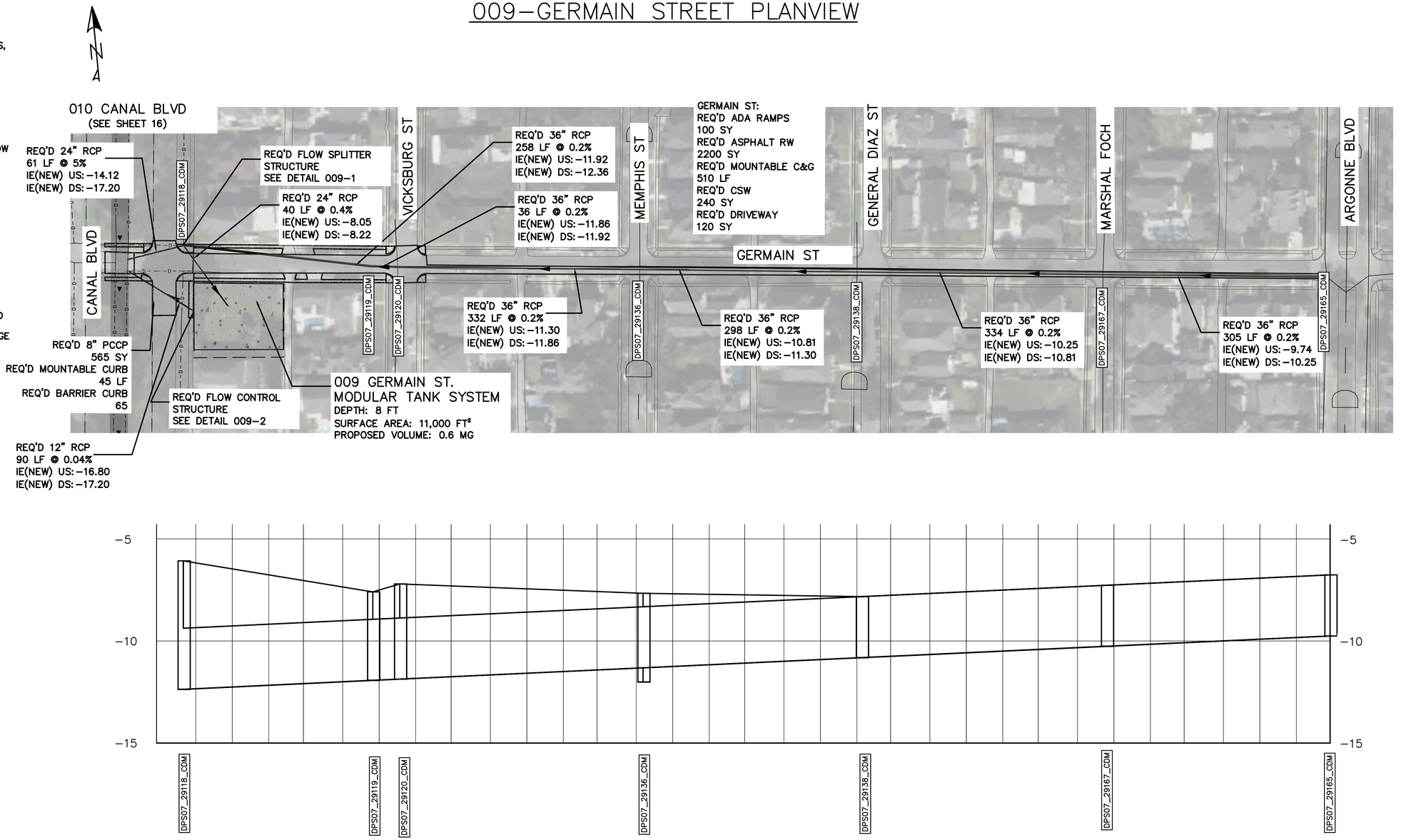

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 70'

0 70 140 280

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 13

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15595 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

SCALE 1"=70' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 13 OF 27

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

009–GERMAIN STREET PLANVIEW

PLANVIEW (11 OF 25)

010.1 CANAL NEUTRAL GROUND PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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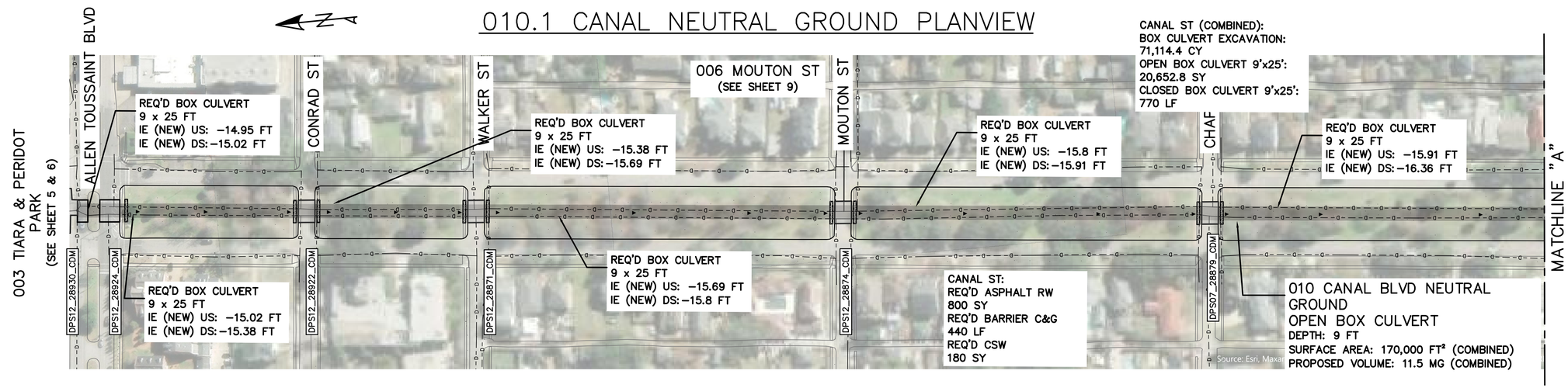

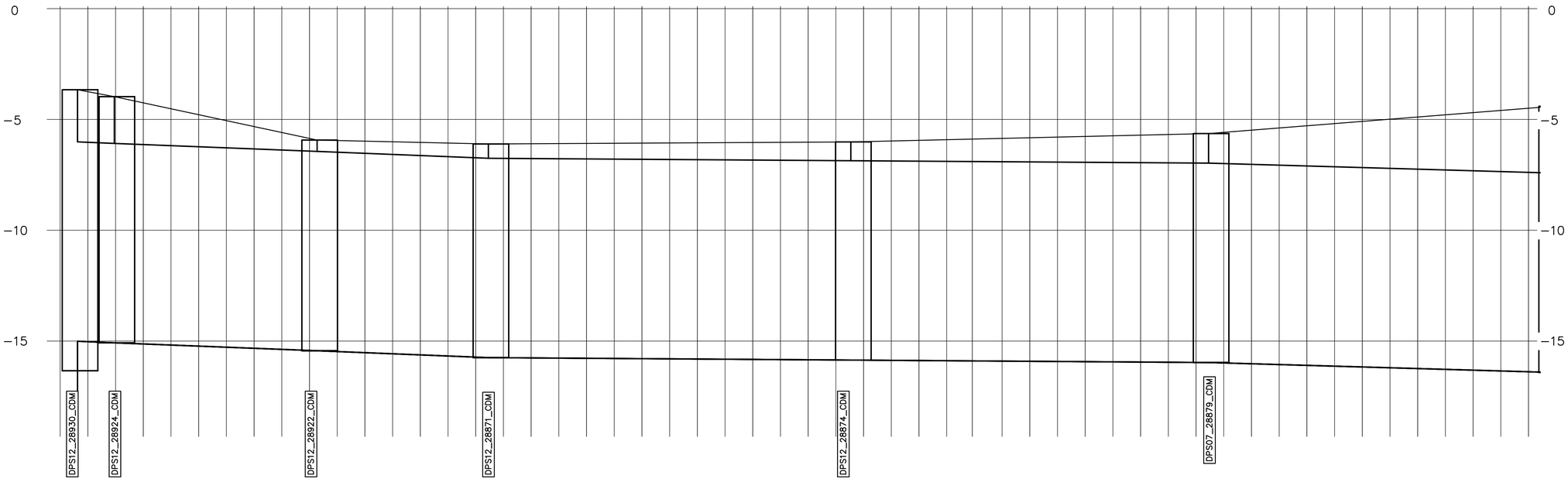

LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 14

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 PONTCHARTRAIN STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

SCALE 1"=100' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 14 OF 27

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.1 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (12 OF 25)

010.2 CANAL NEUTRAL GROUND PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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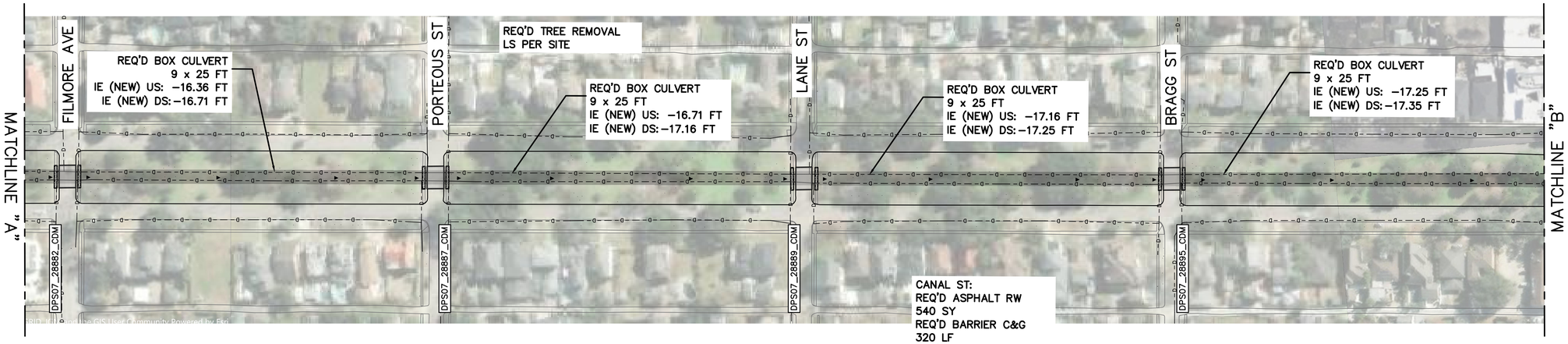
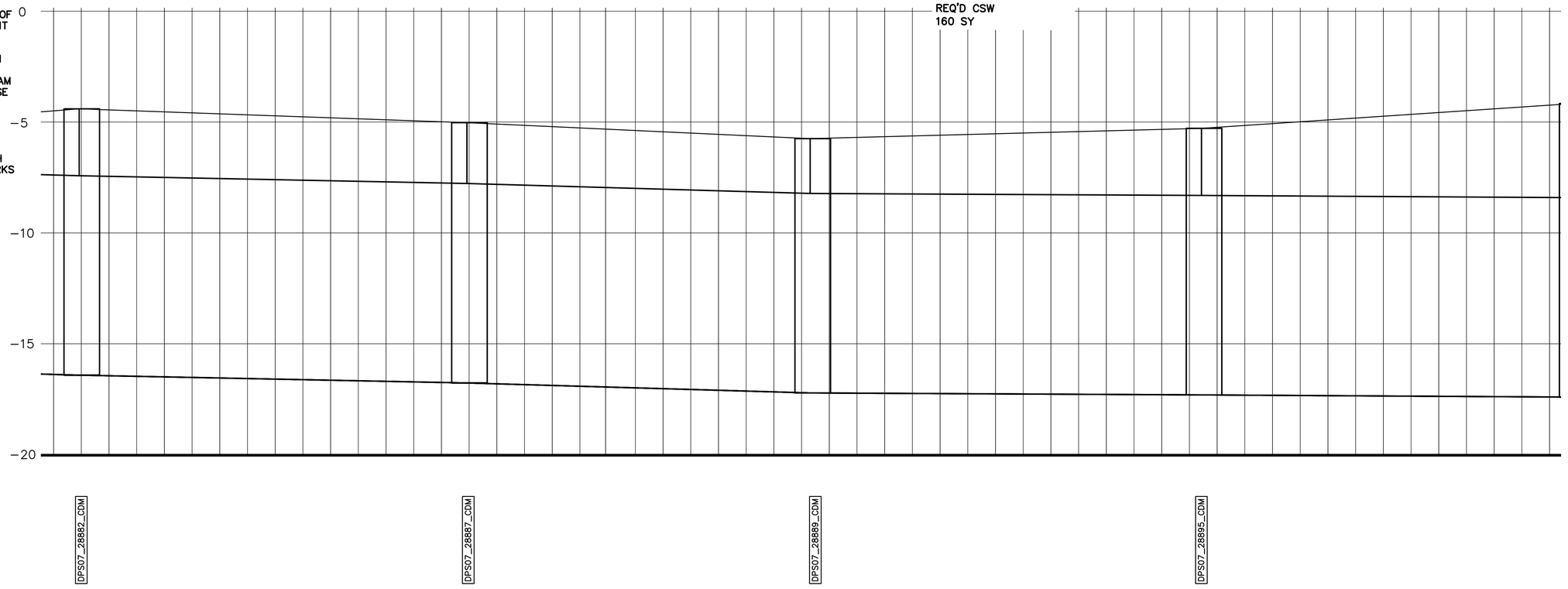




LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 15

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 PONTCHARTRAIN STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 15 OF 27

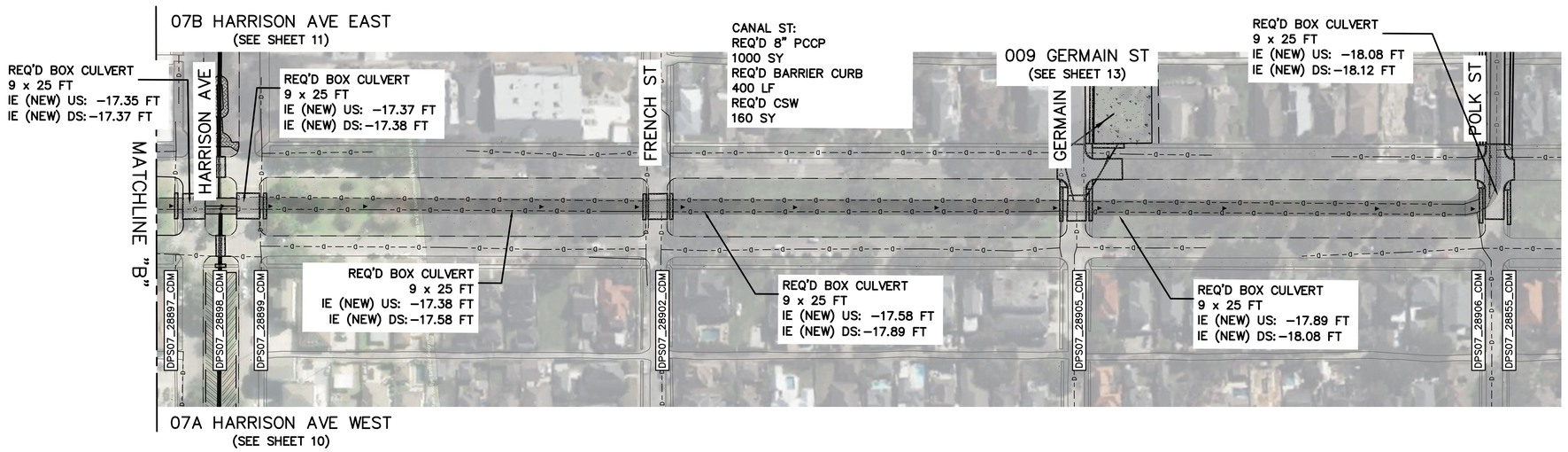
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

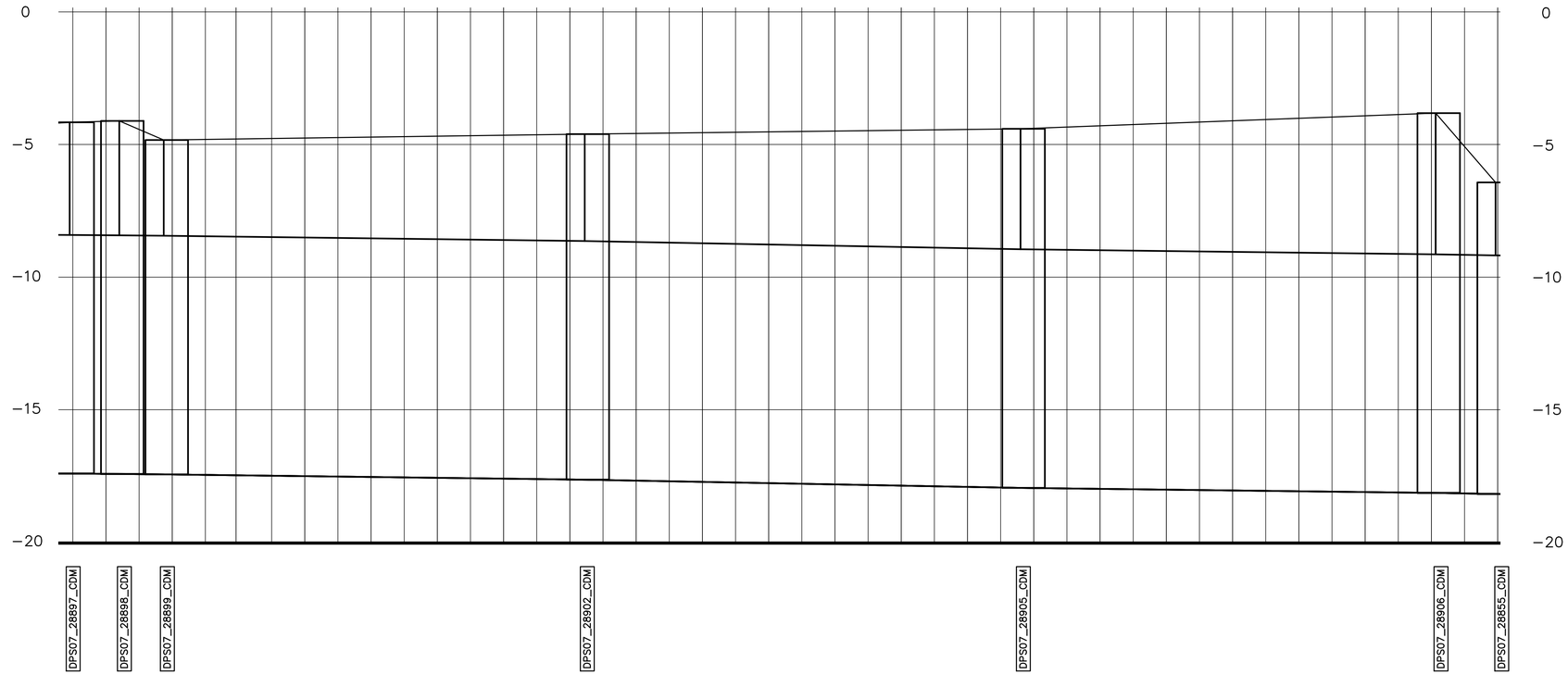
010.2 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (13 OF 25)

010.3 CANAL NEUTRAL GROUND PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
2. THIS CONCEPT USES A FLOW SPLITTER STRUCTURE TO DIVERT FLOW AND ROUTE FLOW INTO A SUBSURFACE MODULAR STORAGE SYSTEM. THE OUTLET WOULD BE CONTROLLED USING AN ORIFICE (OR ACTIVE CONTROLS) AND OVERFLOW WEIR/RISER TO HOLD STORMWATER AFTER THE SYSTEM CAPACITY IS RESTORED IN DOWNSTREAM SYSTEM.
3. IT IS RECOMMENDED THAT A FLAP GATE BE INCLUDED DOWNSTREAM OF THE FACILITY TO PREVENT BACKWATER FILLING THE STORAGE VOLUME AND PRESETTLING AND TRASH COLLECTION BE CONSIDERED AS UPSTREAM END OF FACILITY TO EASE MAINTENANCE AND PRESERVE FUNCTION.
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.





LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 16

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

SCALE 1"=100' HORIZONTAL, 1"=2.5" VERTICAL
DATE JAN. 06, 2025
SHEET 16 OF 27

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.3 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (14 OF 25)

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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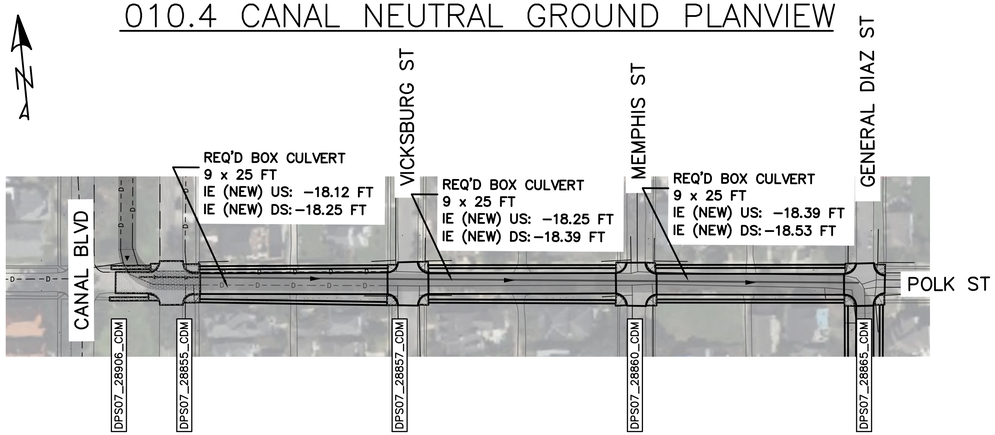
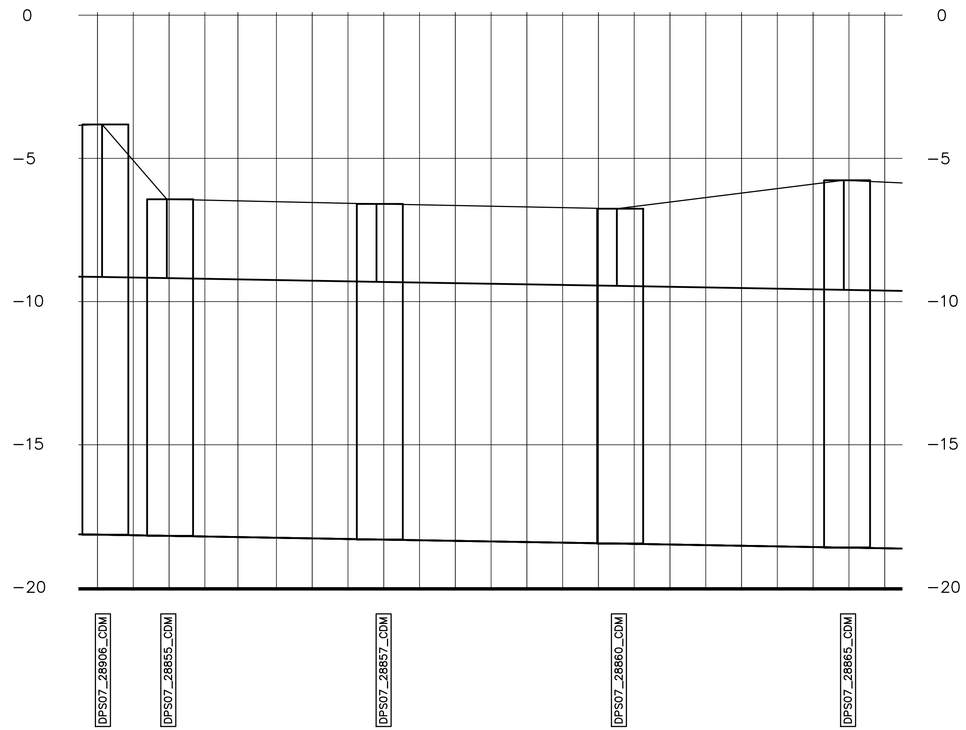
3. IT IS RECOMMENDED THAT A FLAP GATE BE INCLUDED DOWNSTREAM OF THE FACILITY TO PREVENT BACKWATER FILLING THE STORAGE VOLUME AND PRESETTLING AND TRASH COLLECTION BE CONSIDERED AS UPSTREAM END OF FACILITY TO EASE MAINTENANCE AND PRESERVE FUNCTION.
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

010.4 CANAL NEUTRAL GROUND PLANVIEW





POLK ST:
REQ'D ADA RAMPS
200 SY
REQ'D ASPHALT RW
3425 SY
REQ'D MOUNTABLE C&G
1600 LF
REQ'D CSW
750 SY
REQ'D DRIVEWAY
340 SY

POLK TO PUMP STATION (COMBINED):
CLOSED BOX CULVERT 9'x25':
3899 LF

LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 17

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15595 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 17 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.4 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (15 OF 25)

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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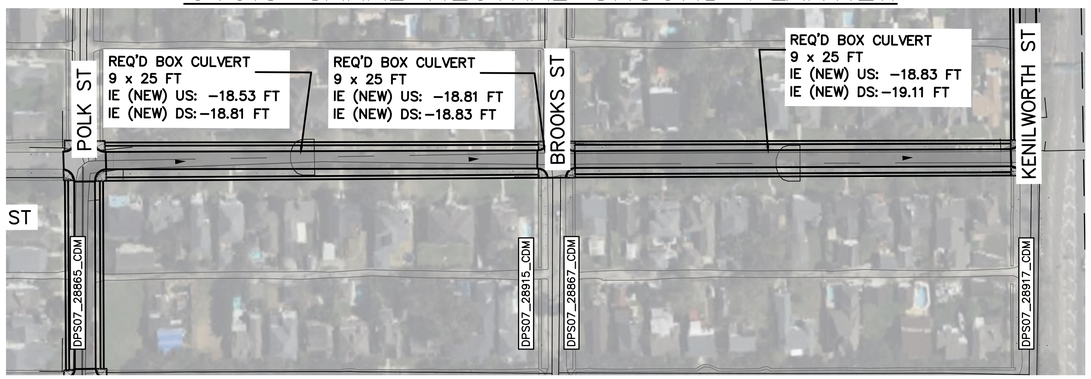
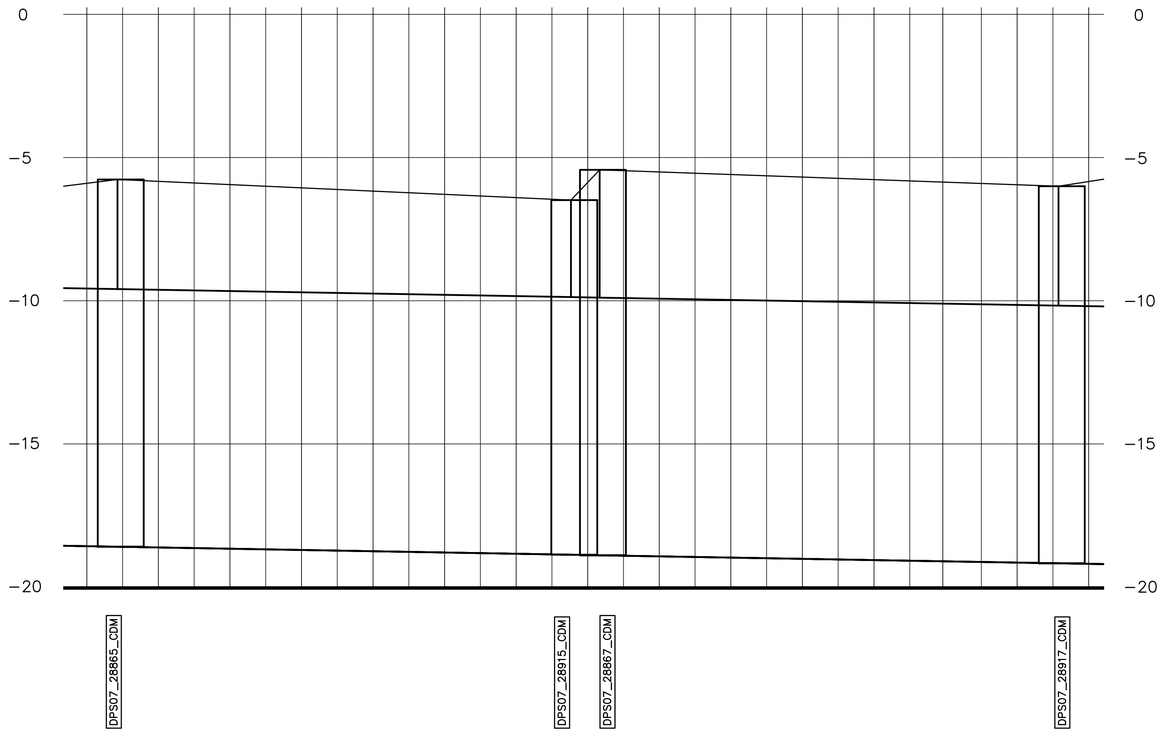
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

010.5 CANAL NEUTRAL GROUND PLANVIEW



GENERAL DIAZ ST:
REQ'D ADA RAMPS
75 SY
REQ'D ASPHALT RW
3700 SY
REQ'D MOUNTABLE C&G
2400 LF
REQ'D CSW
1100 SY
REQ'D DRIVEWAY
120 SY



LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 18

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15505 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DETAILED AED
CHECKED TMK
DATE JAN. 06, 2025
SHEET 18 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.5 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (16 OF 25)

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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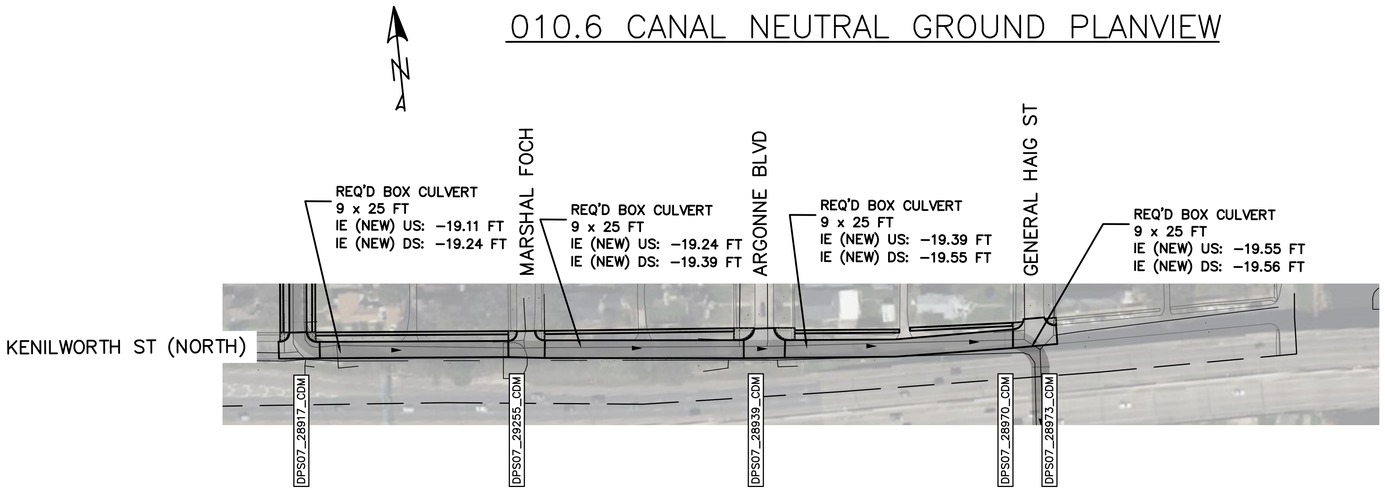
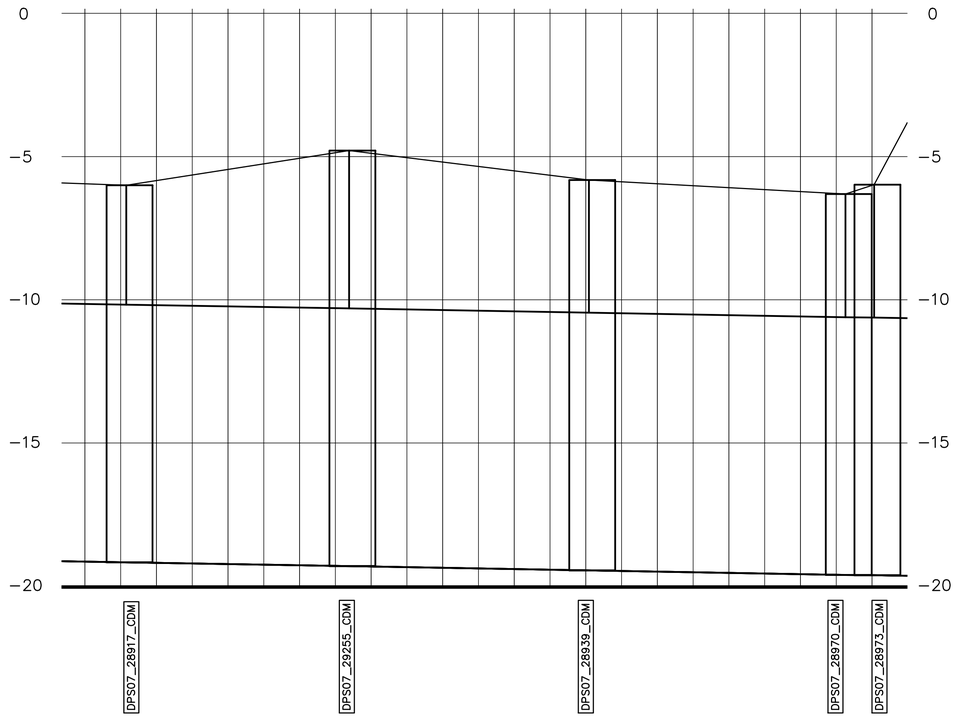
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

010.6 CANAL NEUTRAL GROUND PLANVIEW





KENILWORTH ST (NORTH):
REQ'D ADA RAMPS
75 SY
REQ'D ASPHALT RW
3000 SY
REQ'D MOUNTABLE C&G
2100 LF
REQ'D CSW
410 SY
REQ'D DRIVEWAY
140 SY

LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 19

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15505 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 19 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.6 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (17 OF 25)

010.7 CANAL NEUTRAL GROUND PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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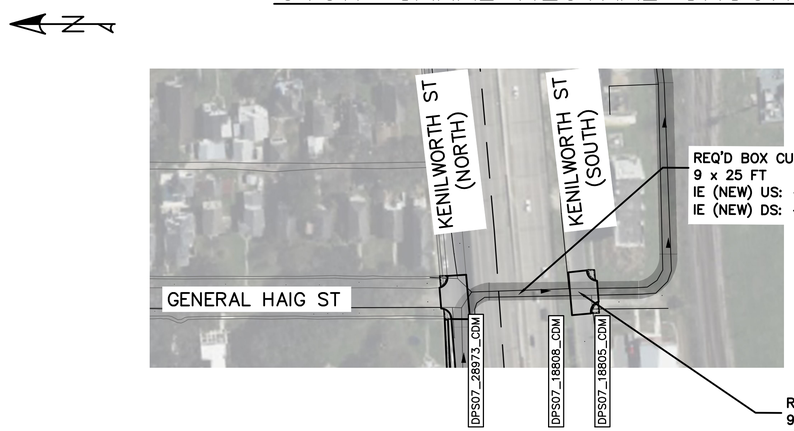

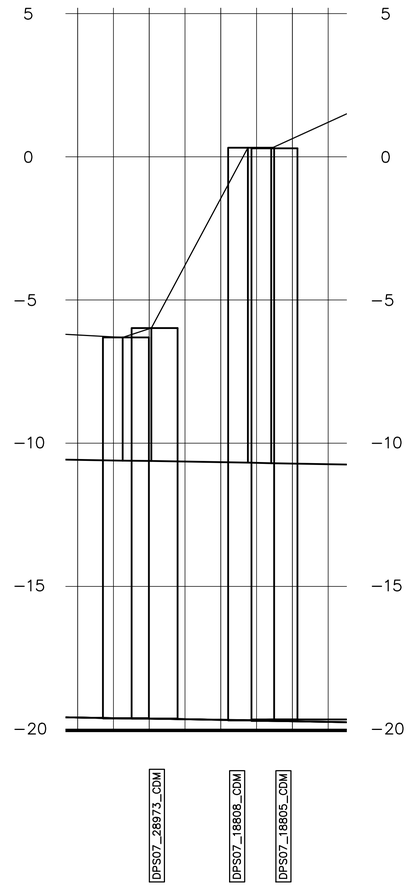

LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 20

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 20 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.7 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (18 OF 25)

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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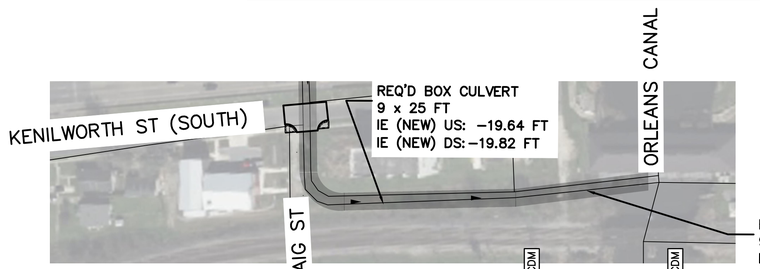
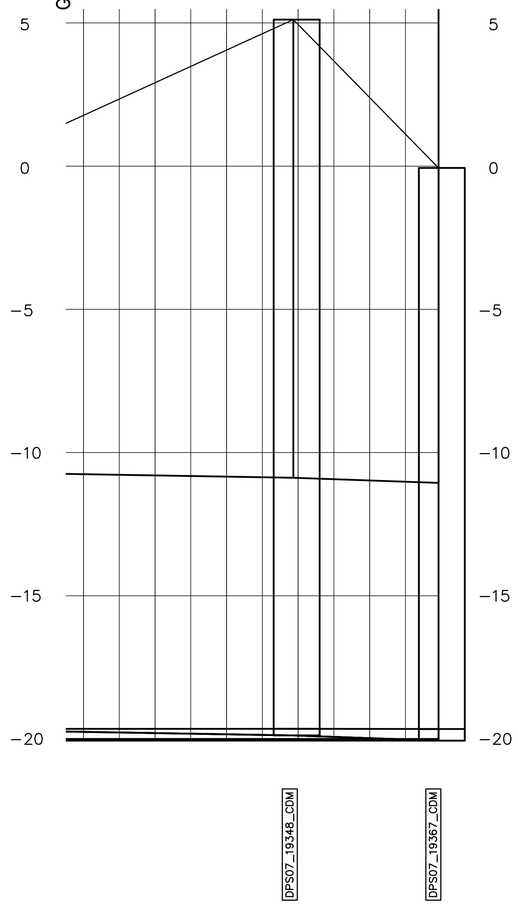
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

010.8 CANAL NEUTRAL GROUND PLANVIEW



KENILWORTH ST (SOUTH):
REQ'D ADA RAMPS
25 SY
REQ'D ASPHALT RW
230 SY
REQ'D MOUNTABLE C&G
40 LF



LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 100'

0 100 200 400

VERTICAL SCALE : 1" = 2.5'

0 2.5 5 10

SHEET NUMBER 21

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK

SCALE 1"=100' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 21 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

010.8 CANAL NEUTRAL GROUND PLANVIEW

PLANVIEW (19 OF 25)

011.1–NEW BASIN CANAL PARK PLANVIEW

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

007A HARRISON AVE (WEST)
(SEE SHEET 10)

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

SCALE : 1" = 80'

0 80 160 320

SHEET NUMBER 22

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=80' HORIZONTAL
DATE JAN. 06, 2025
SHEET 22 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S
011.1–NEW BASIN CANAL PARK PLANVIEW
PLANVIEW (20 OF 25)

NOTES:
1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
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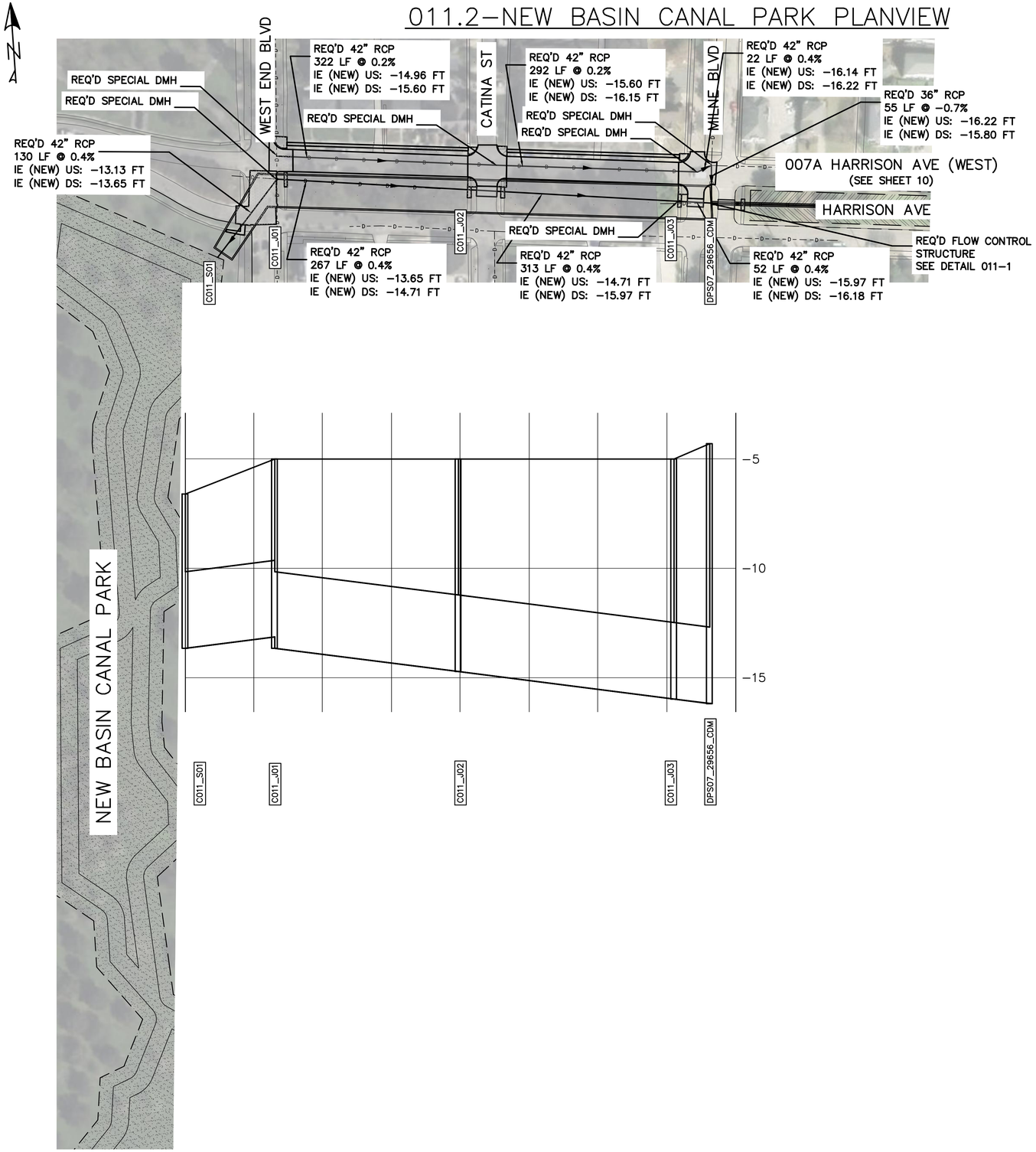
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

011.2–NEW BASIN CANAL PARK PLANVIEW



HARRISON AVE:
REQ'D ADA RAMPS
25 SY
REQ'D 8" PCCP
563 SY
REQ'D BARRIER CURB
95 LF
REQ'D CSW
250 SY
REQ'D ASPHALT RW
2500 SY
REQ'D BARRIER C&G
48 LF
REQ'D MOUNTABLE C&G
500 LF
REQ'D 6" DRIVEWAY
120 SY

LEGEND
- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

HORIZONTAL SCALE : 1" = 80'
0 80 160 320
VERTICAL SCALE : 1" = 2.5'
0 2.5 5 10

SHEET NUMBER 23

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
1555S POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

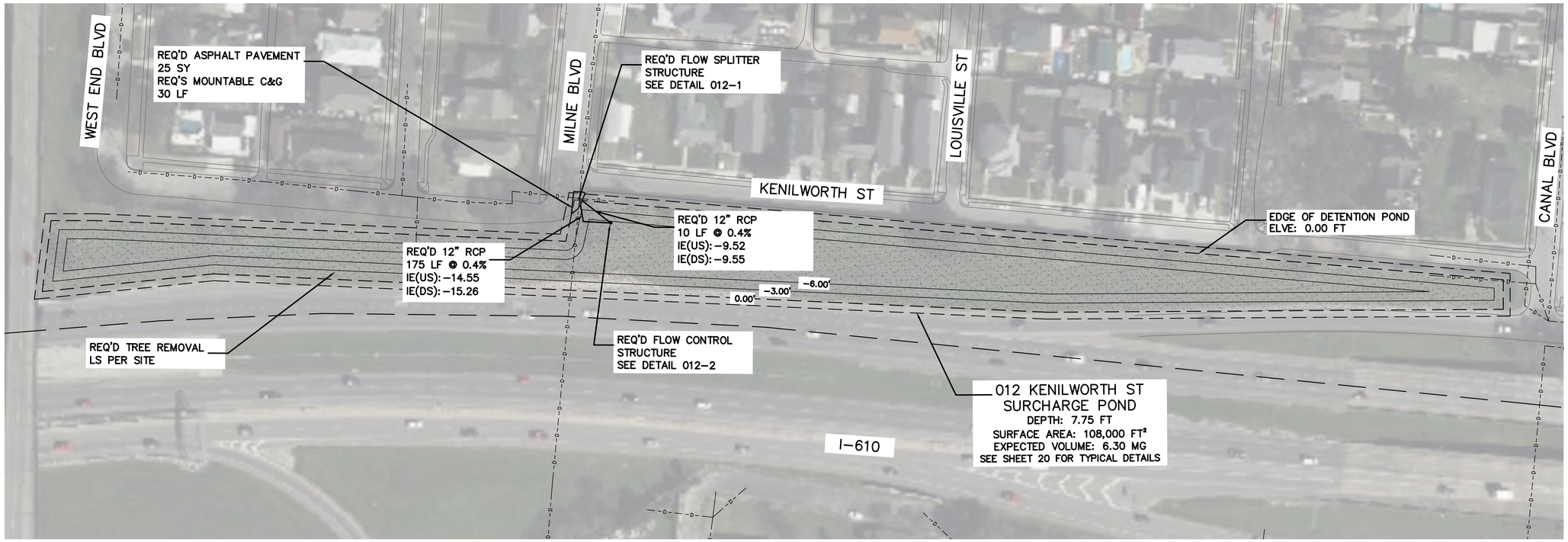
DESIGNED AED
CHECKED TMK
DETAILED AED
CHECKED TMK
SCALE 1"=80' HORIZONTAL, 1"=2.5' VERTICAL
DATE JAN. 06, 2025
SHEET 23 OF 27

CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

011.2–NEW BASIN CANAL PARK PLANVIEW

PLANVIEW (21 OF 25)

012–KENILWORTH ST PLANVIEW



LEGEND

- PROJECT AREA
- MODULAR TANK SYSTEM
- STORMWATER PARK
- DETENTION BASIN CONTOUR
- PERMEABLE PAVERS
- GREEN ROOF
- BIOSWALE
- EXISTING DRAINLINE
- OPEN BOX CULVERT
- SUNKEN GARDEN
- BOX CULVERT
- JUNCTION
- CONDUIT
- PORTLAND CEMENT CONCRETE
- ASPHALT PAVEMENT

NOTES:

1. THE DIMENSIONS, ELEVATIONS, VOLUMES, AND ALIGNMENTS OF PROJECT COMPONENTS (PIPES, WEIRS, ORIFICES, VAULTS, GRADING) ARE INDICATIVE OF THE GENERALIZED CONCEPT AND WOULD BE REFINED DURING DETAILED DESIGN FOLLOWING COLLECTION OF A DETAILED TOPOGRAPHIC AND INFRASTRUCTURE SURVEY AS WELL AS ADDITIONAL MODEL OPTIMIZATION RUNS.
2. THIS CONCEPT USES A FLOW SPLITTER STRUCTURE TO DIVERT FLOW AND ROUTE FLOW INTO A SUBSURFACE MODULAR STORAGE SYSTEM. THE OUTLET WOULD BE CONTROLLED USING AN ORIFICE (OR ACTIVE CONTROLS) AND OVERFLOW WEIR/RISER TO HOLD STORMWATER AFTER THE SYSTEM CAPACITY IS RESTORED IN DOWNSTREAM SYSTEM.
3. IT IS RECOMMENDED THAT A FLAP GATE BE INCLUDED DOWNSTREAM OF THE FACILITY TO PREVENT BACKWATER FILLING THE STORAGE VOLUME AND PRESETTLING AND TRASH COLLECTION BE CONSIDERED AS UPSTREAM END OF FACILITY TO EASE MAINTENANCE AND PRESERVE FUNCTION.
4. THE SURFACE ABOVE THE STORAGE MAY BE RESTORED TO EXISTING CONDITIONS OR THROUGH PARTNERSHIPS WITH PARKS TO BE IMPROVED WITH PASSIVE OR ACTIVE RECREATION IMPROVEMENTS.

SCALE : 1" = 60'

0 60 120 240

SHEET NUMBER 24

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED
CHECKED	TMK
DETAILED	AED
CHECKED	TMK
SCALE	1"= 60'
DATE	JAN. 06, 2025
SHEET	24 OF 27

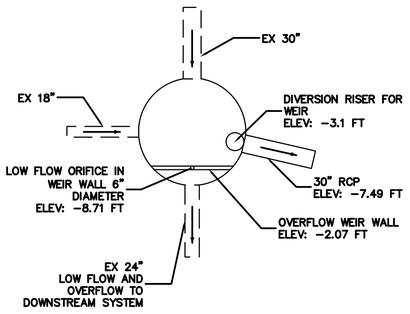
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

012–KENILWORTH ST PLANVIEW

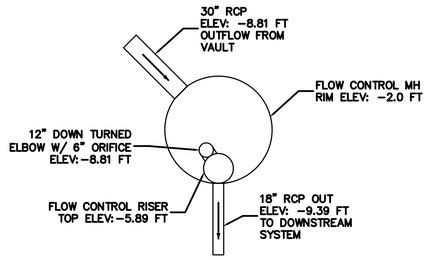
PLANVIEW (22 OF 25)

FLOW SPLITTER AND FLOW CONTROLLER DETAILS –1

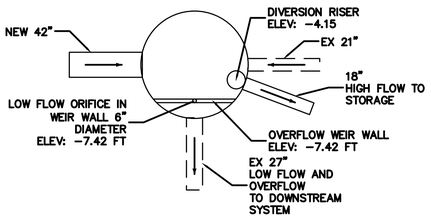
001–1



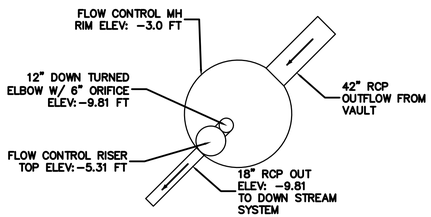
001–2



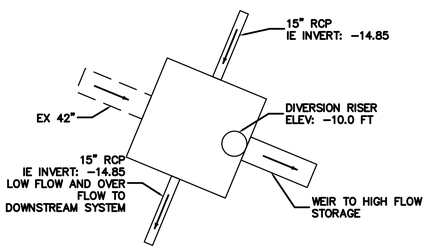
002–1



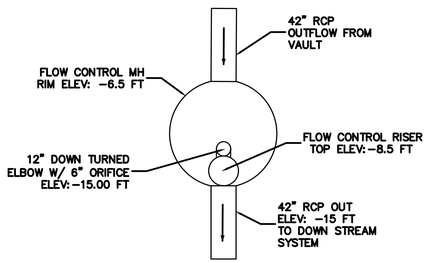
002–2



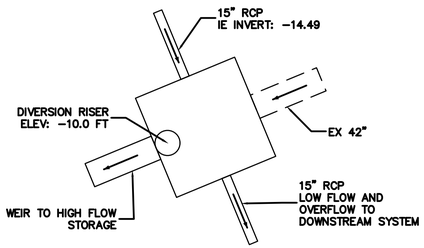
003A–1



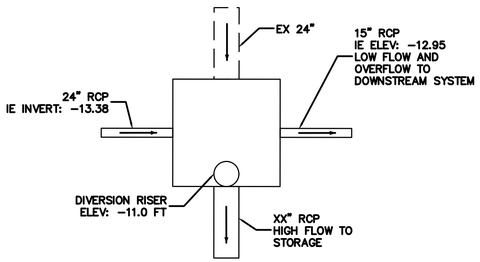
003A–2



003A–3



003A–4



SCALE : N.T.S.

SHEET NUMBER 25

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15595 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED	SCALE	N.T.S.
CHECKED	TMK	DATE	JAN. 06, 2025
DETAILED	AED	SHEET	25 OF 27
CHECKED	TMK		

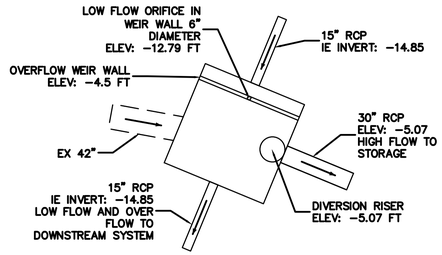
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

FLOW SPLITTER & CONTROLLER DETAILS –1

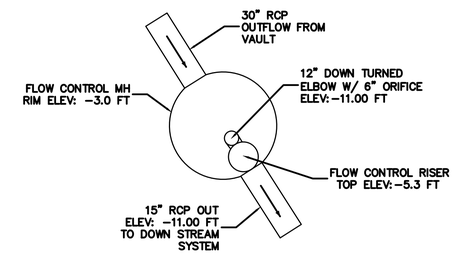
PLANVIEW (23 OF 25)

FLOW SPLITTER AND FLOW CONTROLLER DETAILS –1

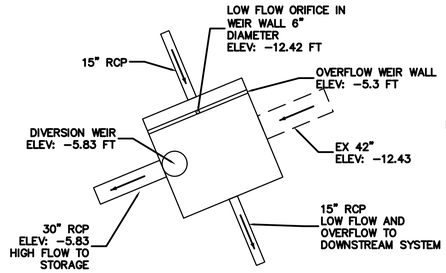
003B–1



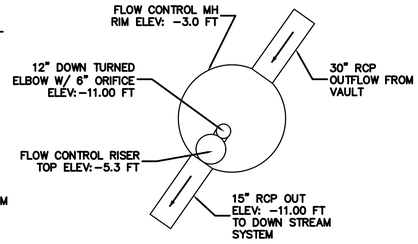
003B–2



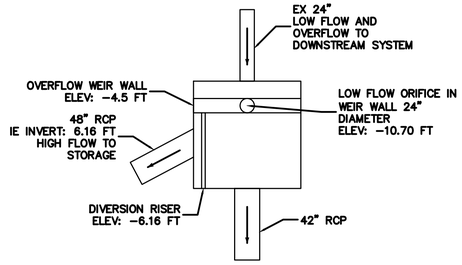
003B–3



003B–4



004–1



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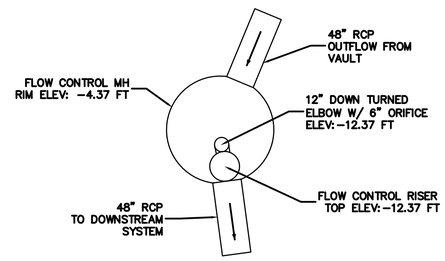

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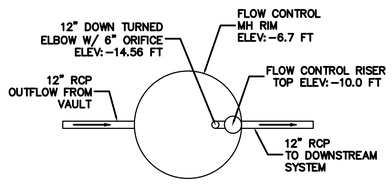
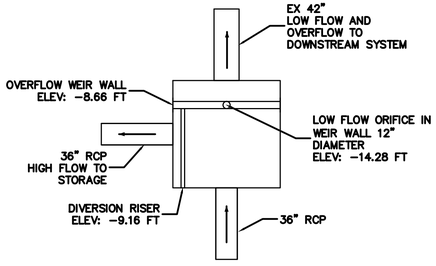


005–2



SCALE : N.T.S.

SHEET NUMBER 26

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15555 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED	SCALE	N.T.S.
CHECKED	TMK	DATE	JAN. 06, 2025
DETAILED	AED	SHEET	26 OF 27
CHECKED	TMK		

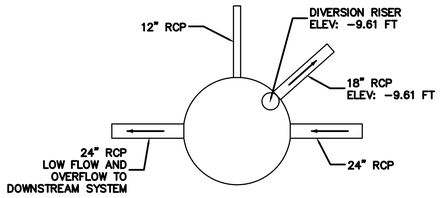
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

FLOW SPLITTER & CONTROLLER DETAILS –2

PLANVIEW (24 OF 25)

FLOW SPLITTER AND FLOW CONTROLLER DETAILS –1

006–1



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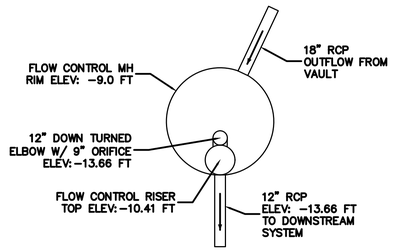
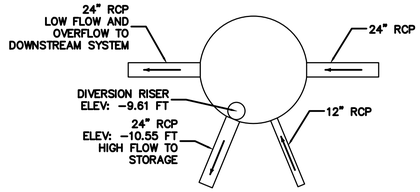
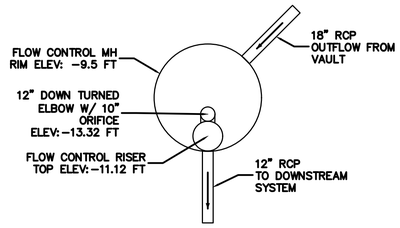


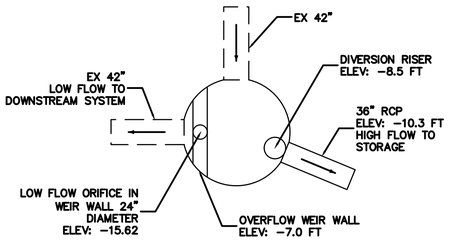
006–3



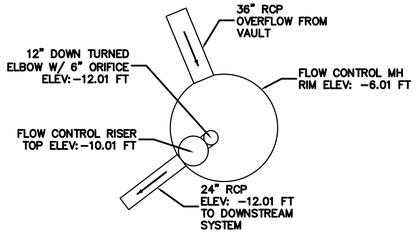
006–4



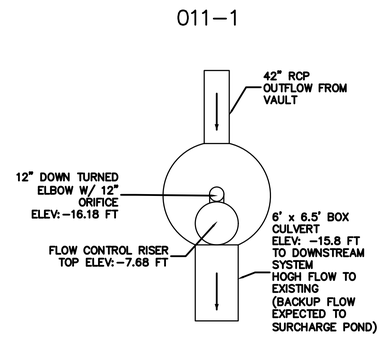
008–1



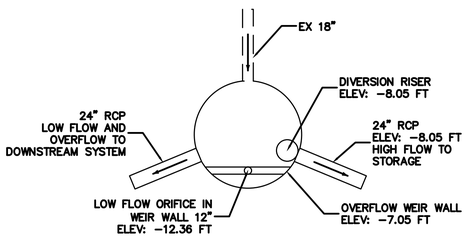
008–2



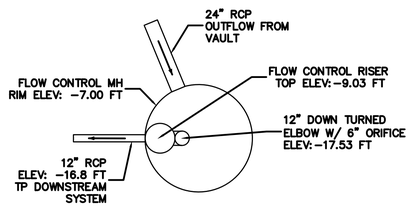
011–1



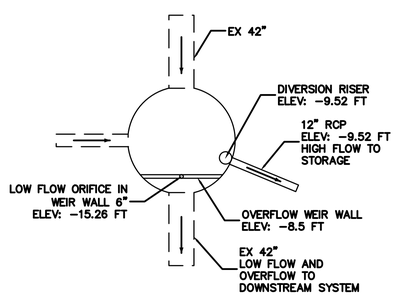
009–1



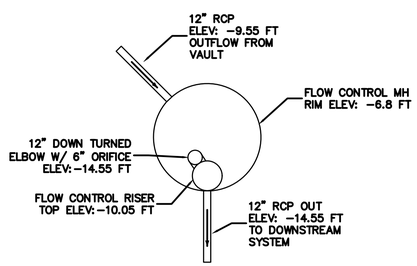
009–2



012–1



012–2



SCALE : N.T.S.

SHEET NUMBER 27

NO.	DATE	REVISION DESCRIPTION	BY

JACOBS ENGINEERING GROUP
15595 POYDRAS STREET, SUITE 1625
NEW ORLEANS, LOUISIANA 70115

DESIGNED	AED	SCALE	N.T.S.	DATE	JAN. 06, 2025
CHECKED	TMK			SHEET	27 OF 27
DETAILED	AED				
CHECKED	TMK				

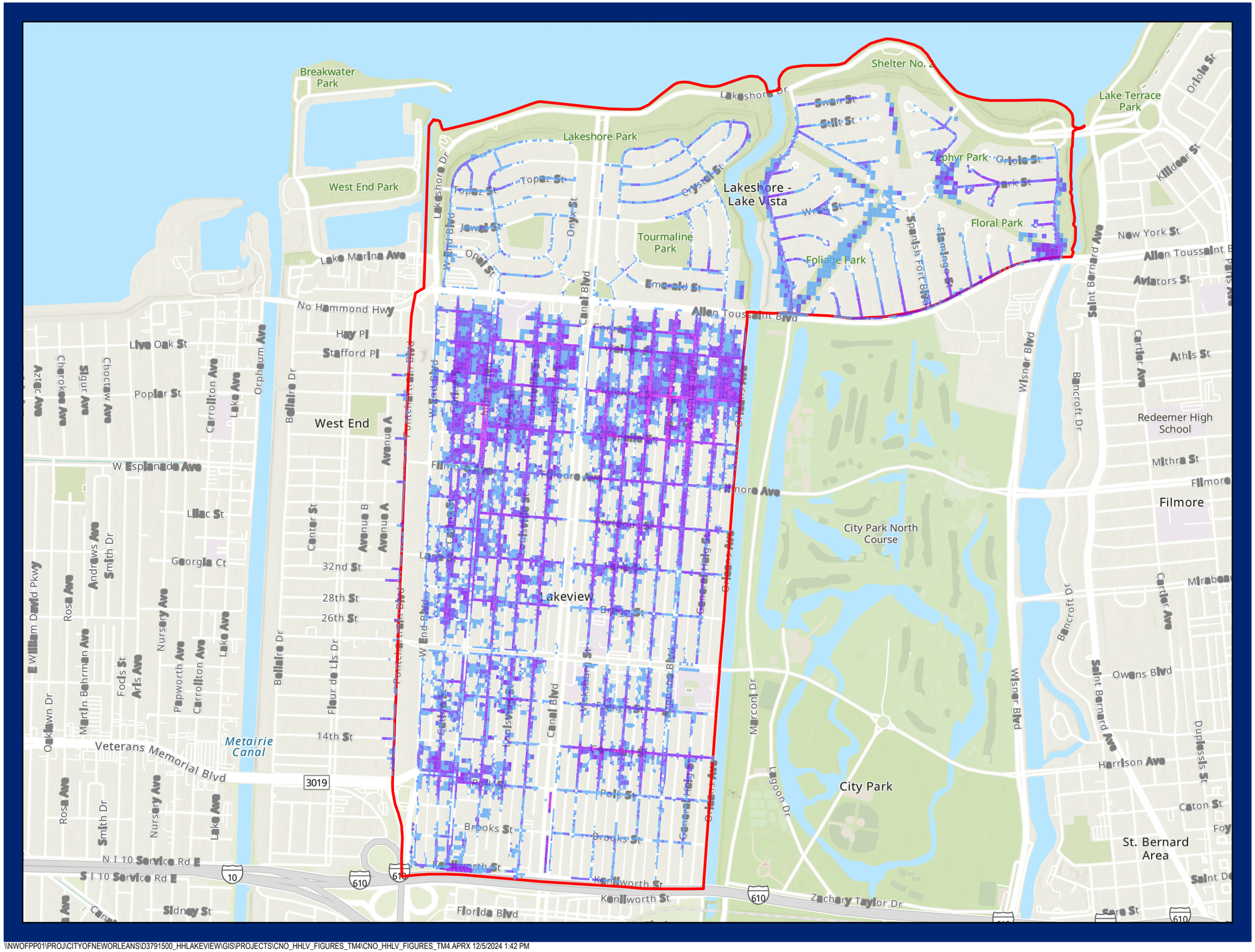
CNO H&H DRAINAGE STUDY – LAKEVIEW N&S

FLOW SPLITTER & CONTROLLER DETAILS –1

PLANVIEW (25 OF 25)

Appendix F. Flood Maps

F.1 Flood Inundation Maps



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

N

0 0.25 0.5 Miles

Figure F- 1
Concept 1 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM

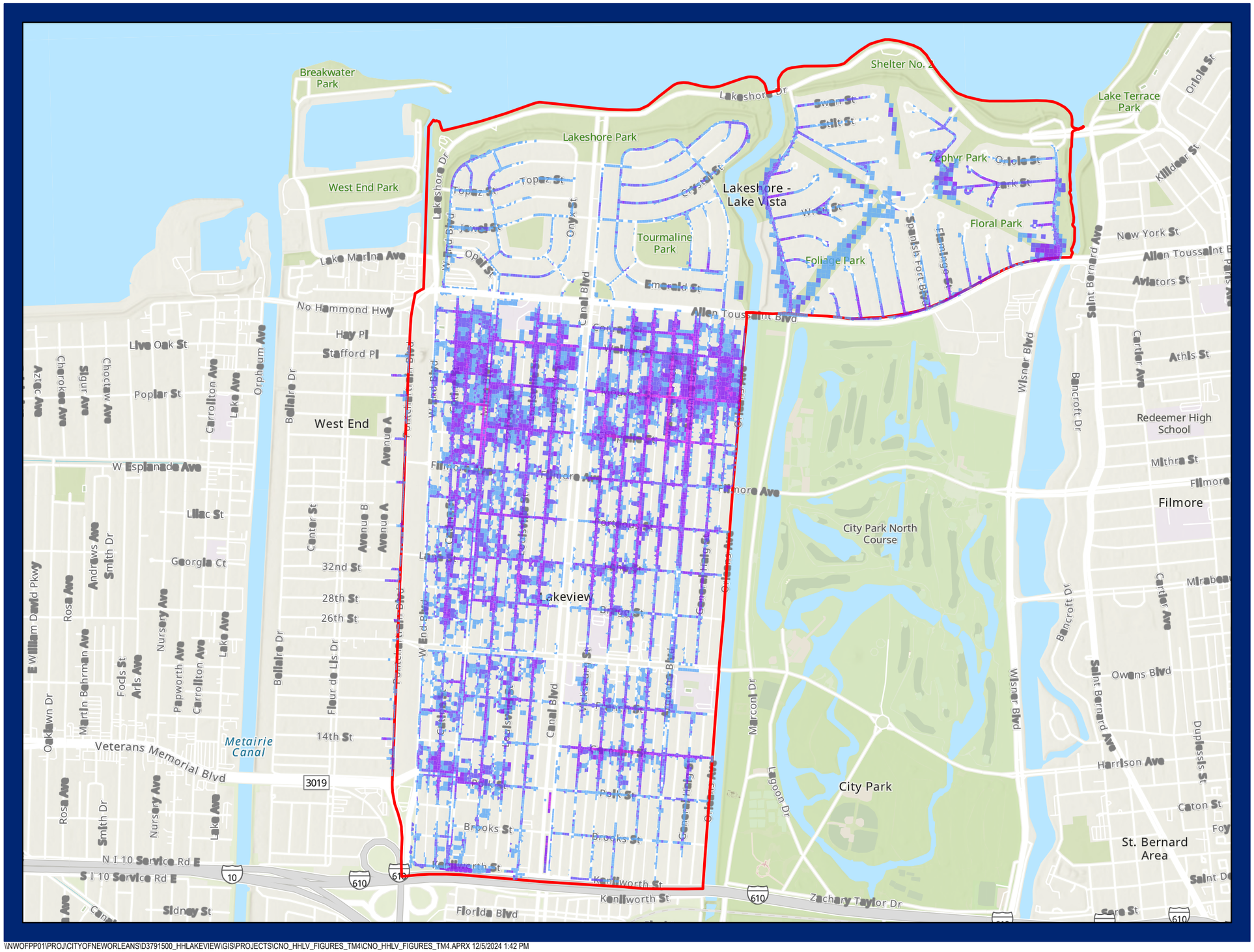
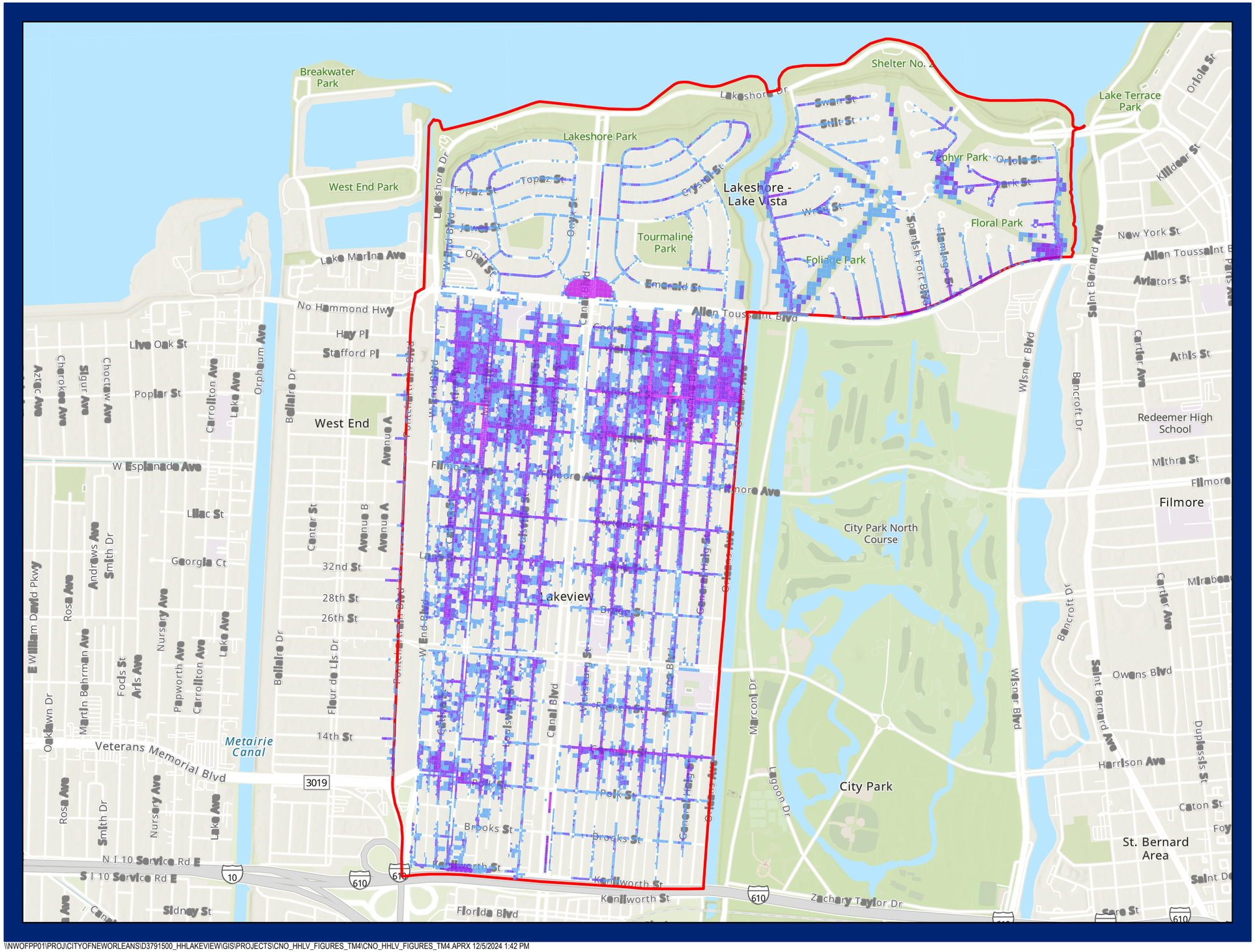


Figure F- 2
Concept 2 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

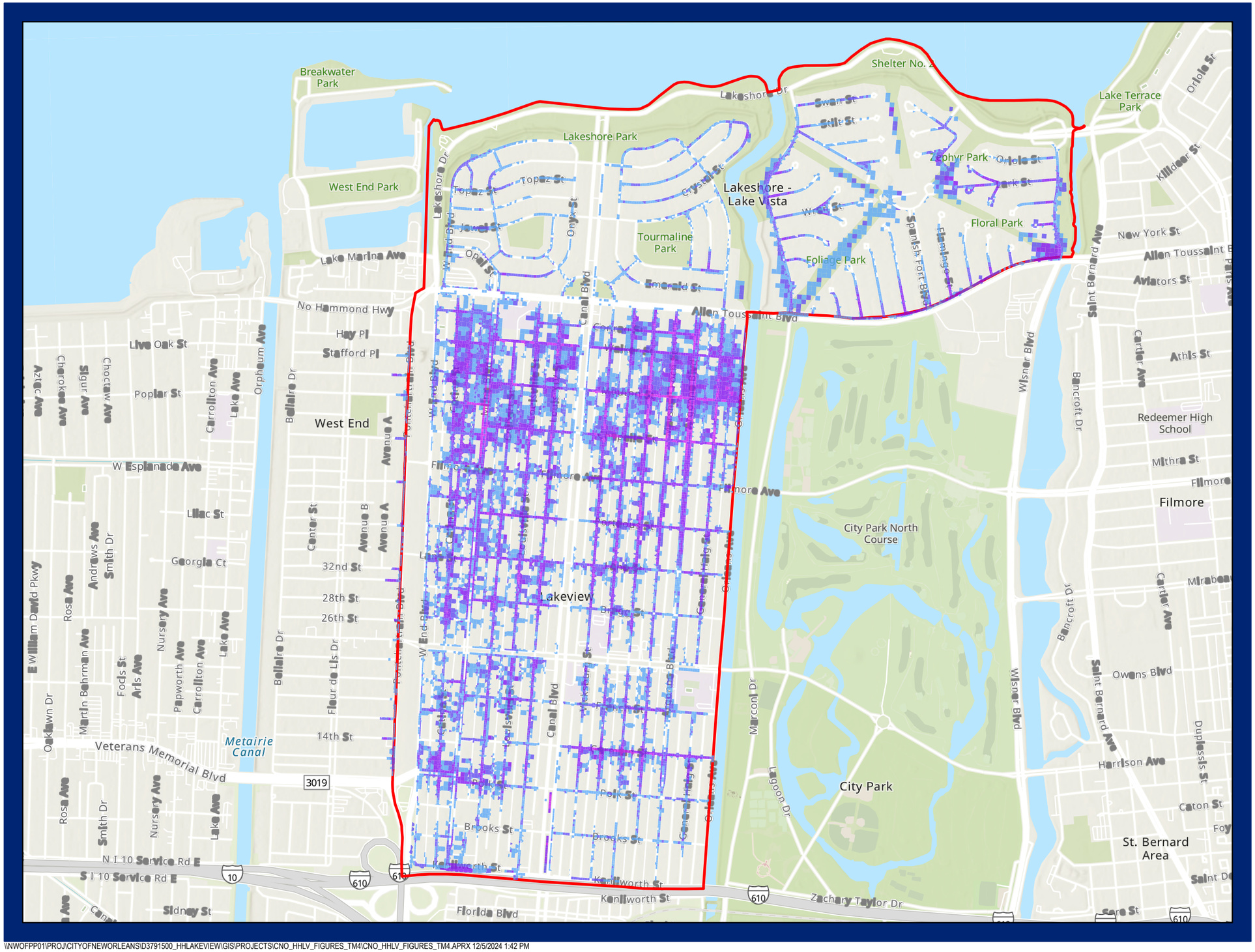
N

0 0.25 0.5 Miles

Figure F- 3
Concept 3A Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

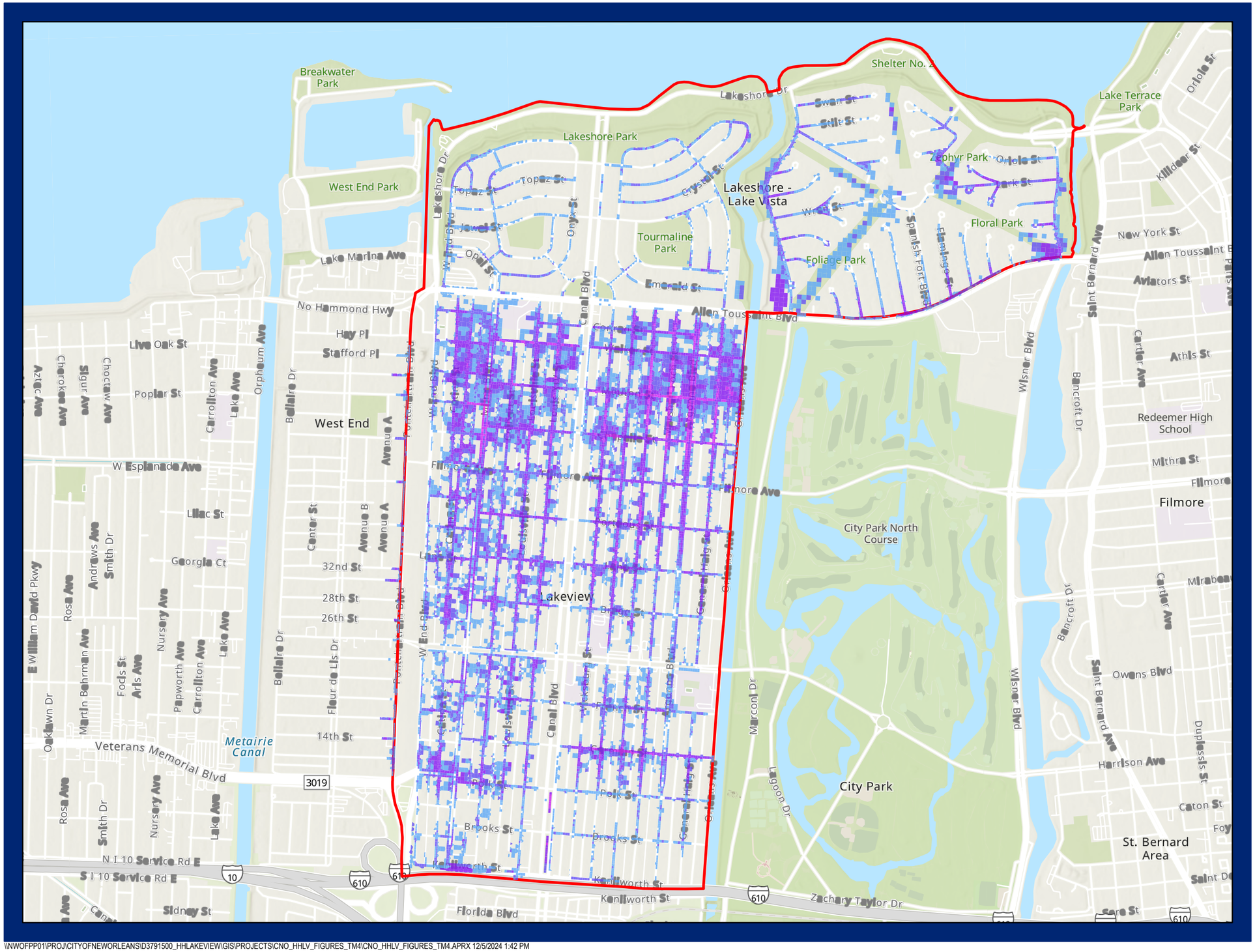
N

0 0.25 0.5 Miles

Figure F- 4
Concept 3B Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

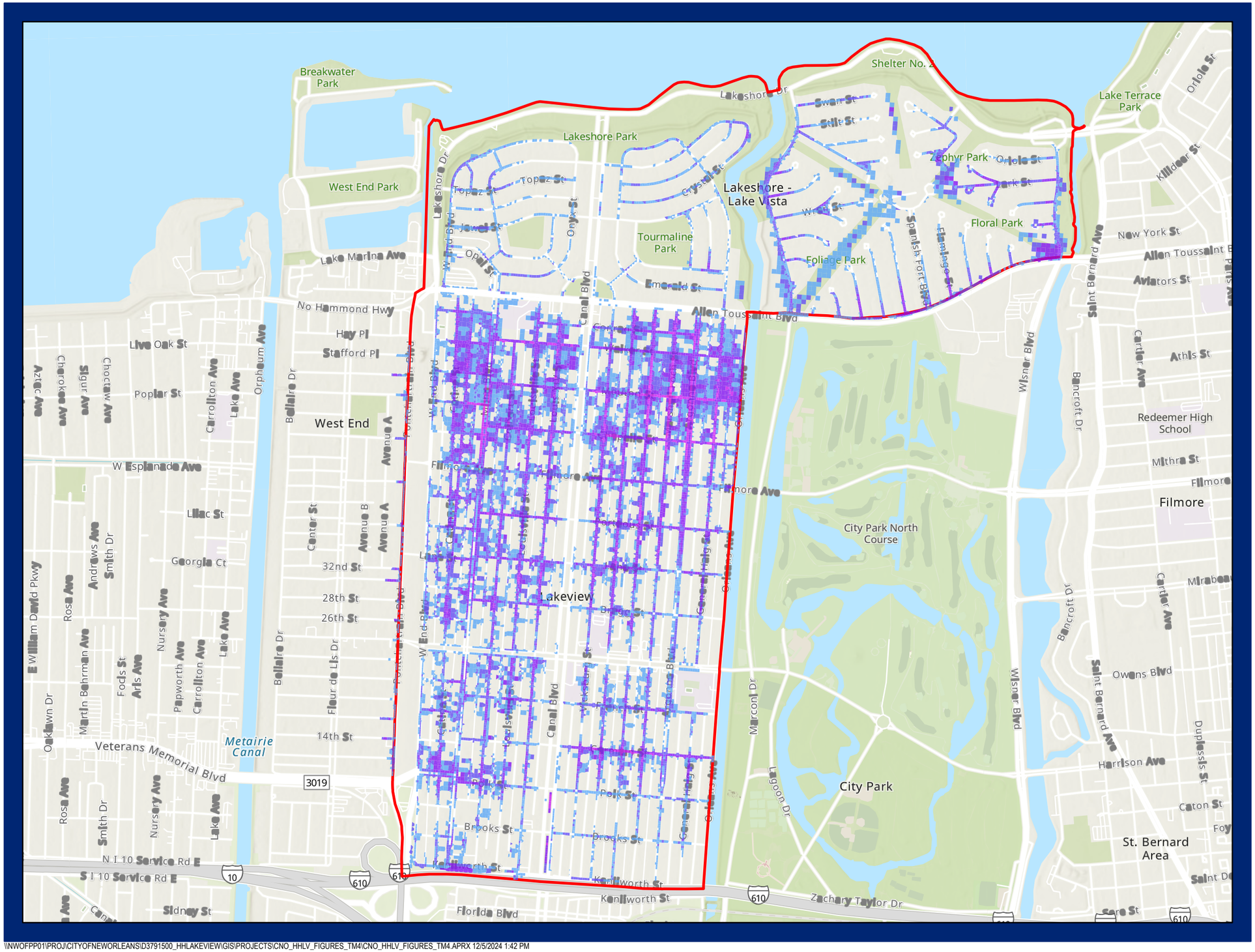
N

0 0.25 0.5 Miles

Figure F- 5
Concept 4 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

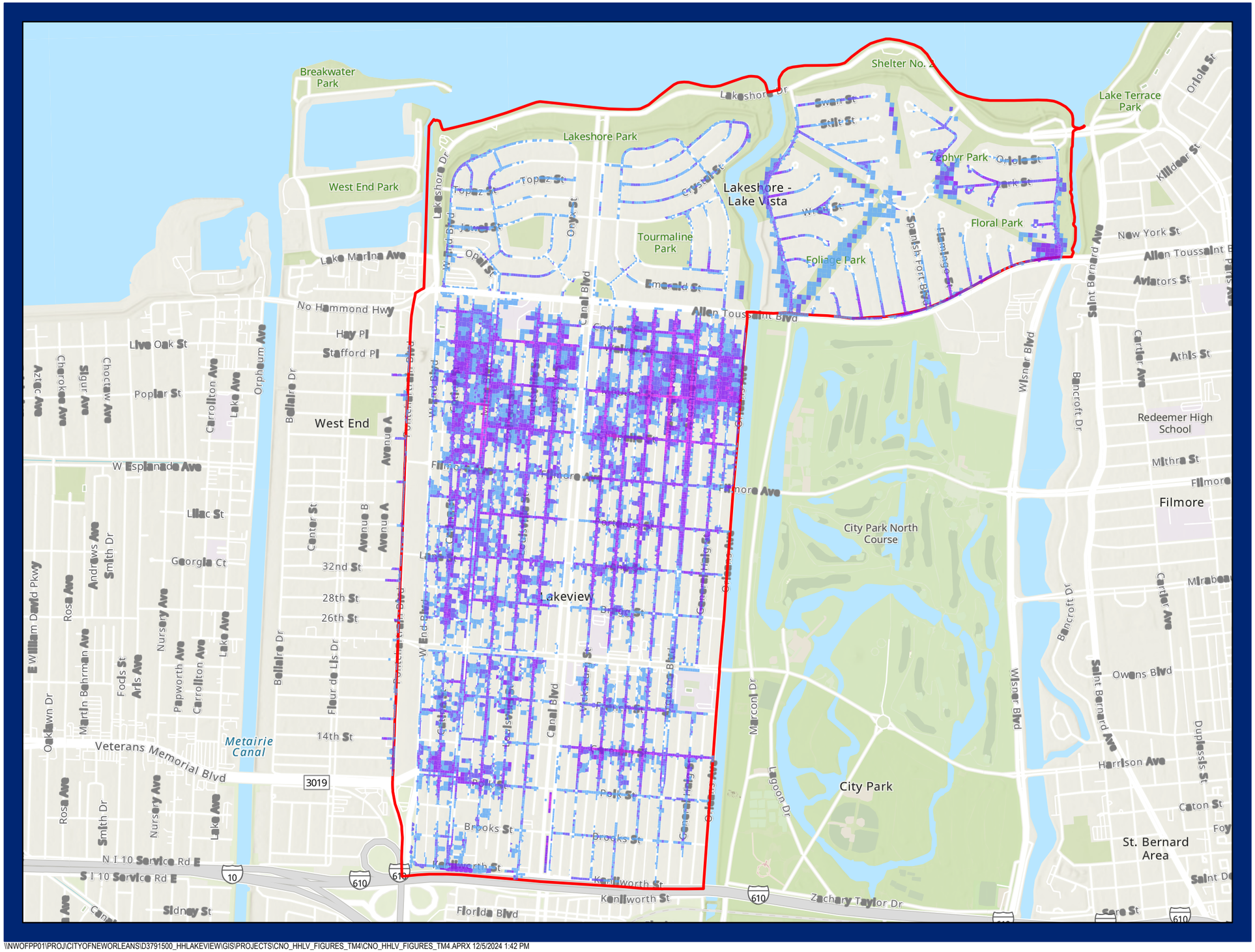
N

0 0.25 0.5 Miles

Figure F- 6
Concept 5 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

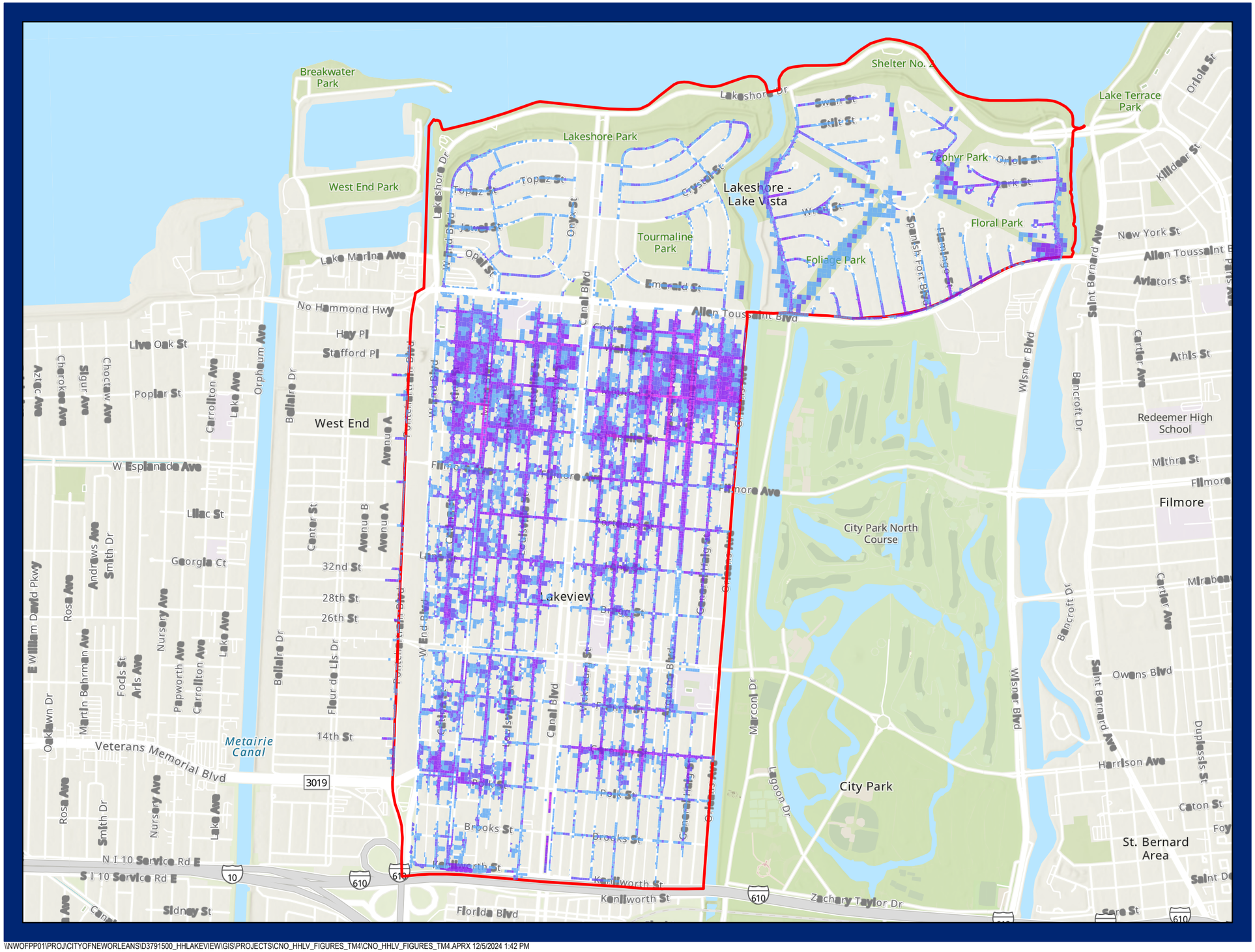
N

0 0.25 0.5 Miles

Figure F- 7
Concept 6 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

N

0 0.25 0.5 Miles

Figure F- 8
Concept 7 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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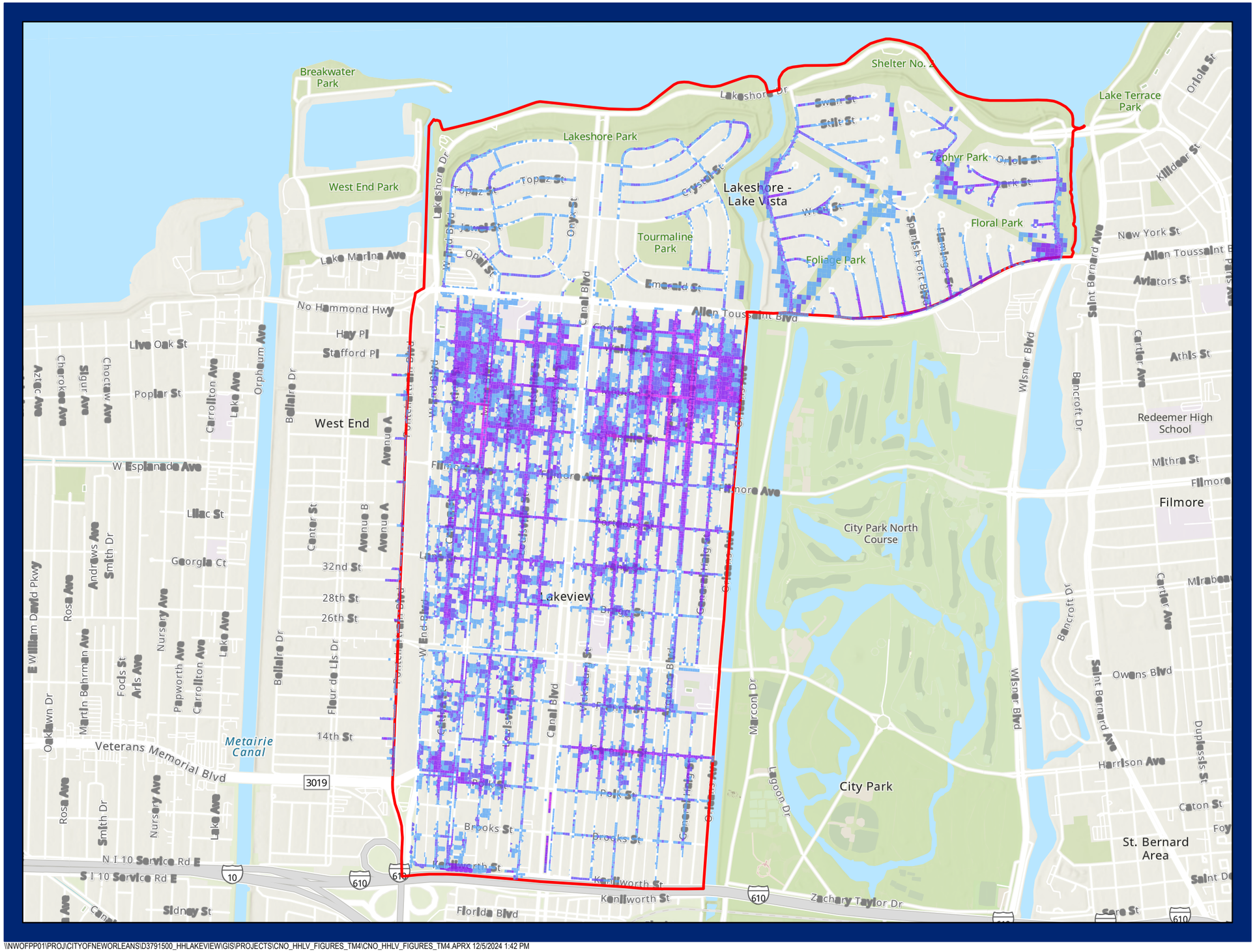


LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

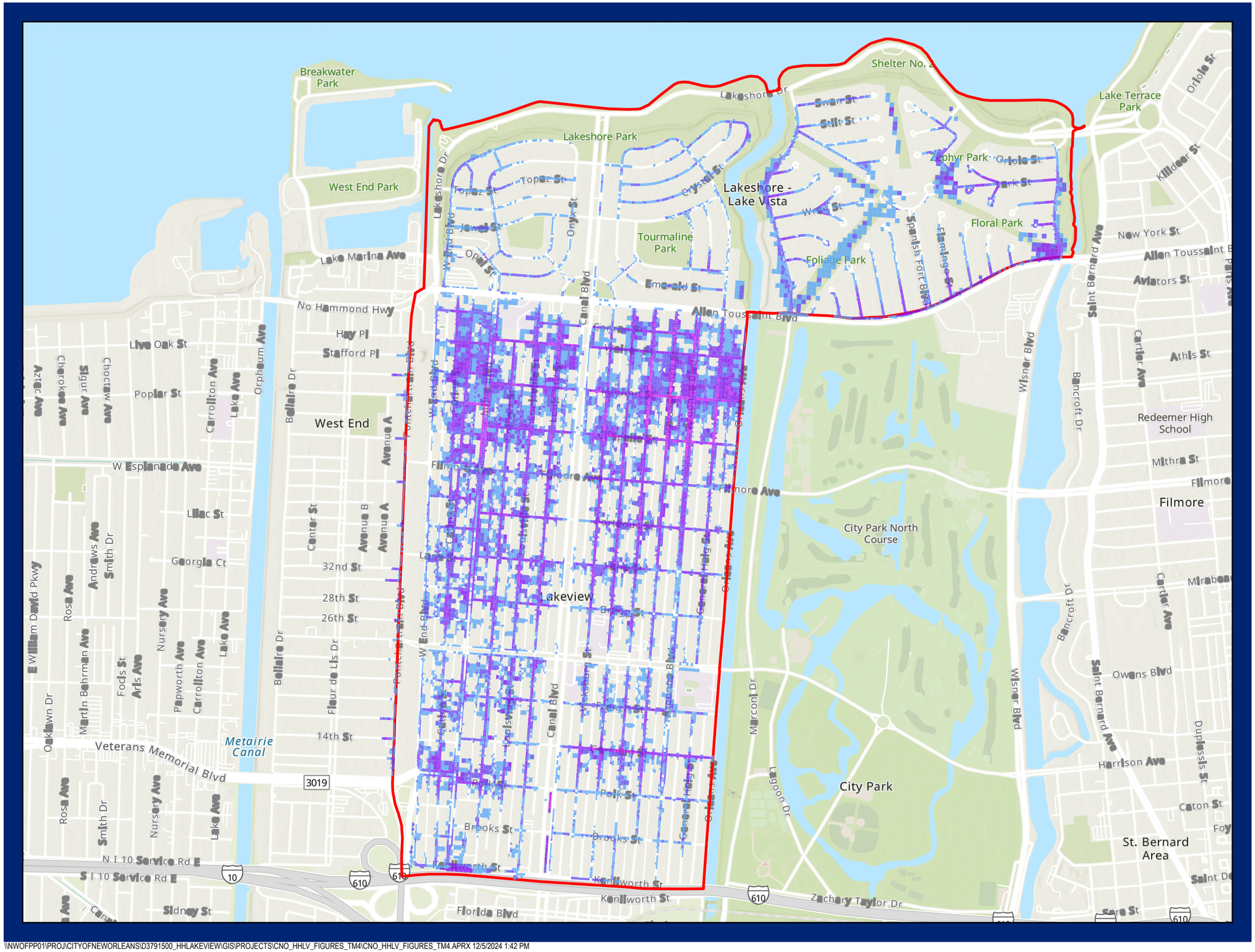
N

0 0.25 0.5 Miles

Figure F- 9
Concept 8 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

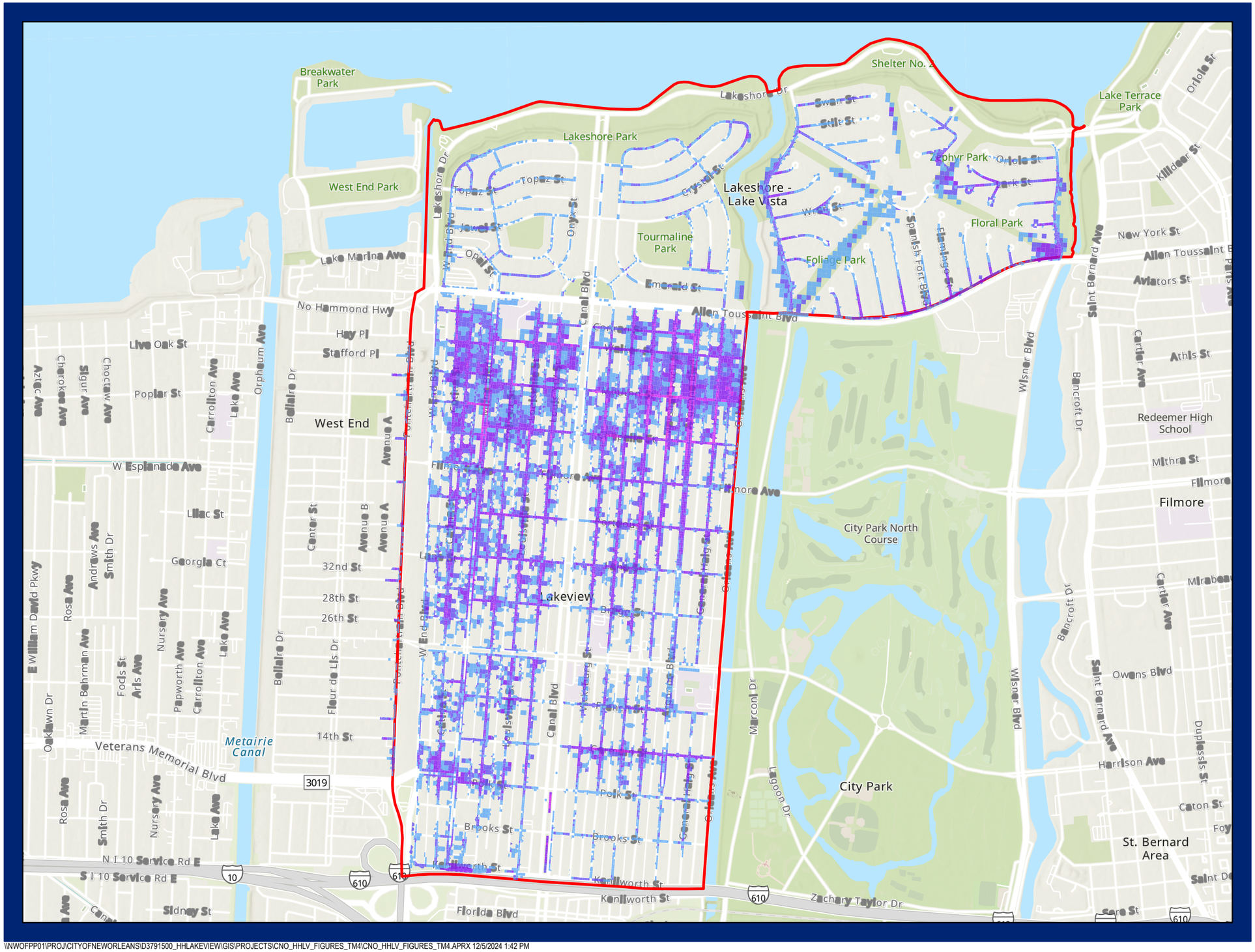
N

0 0.25 0.5 Miles

Figure F- 10
Concept 9 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

N

0 0.25 0.5 Miles

Figure F- 11
Concept 10 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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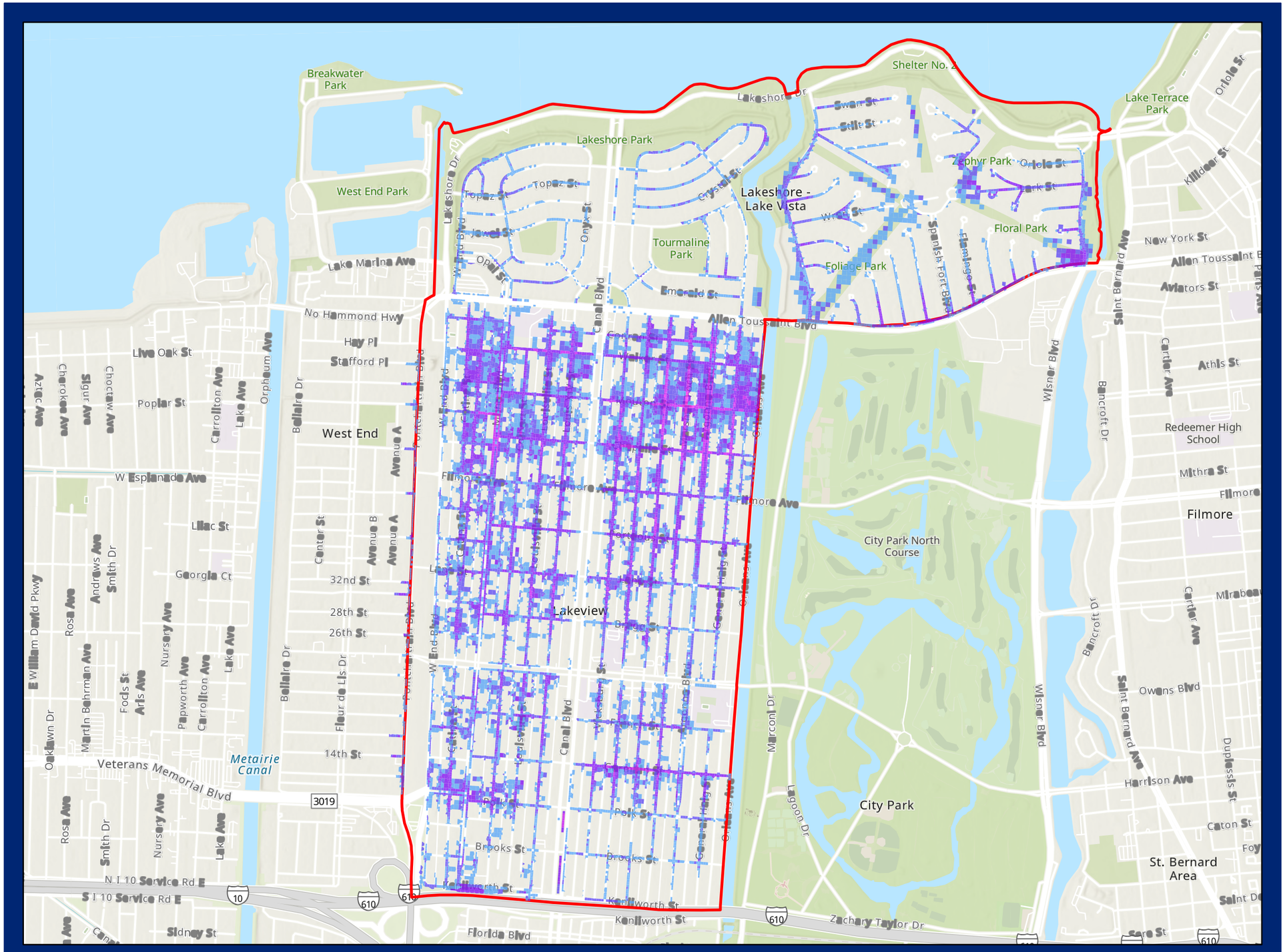
\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

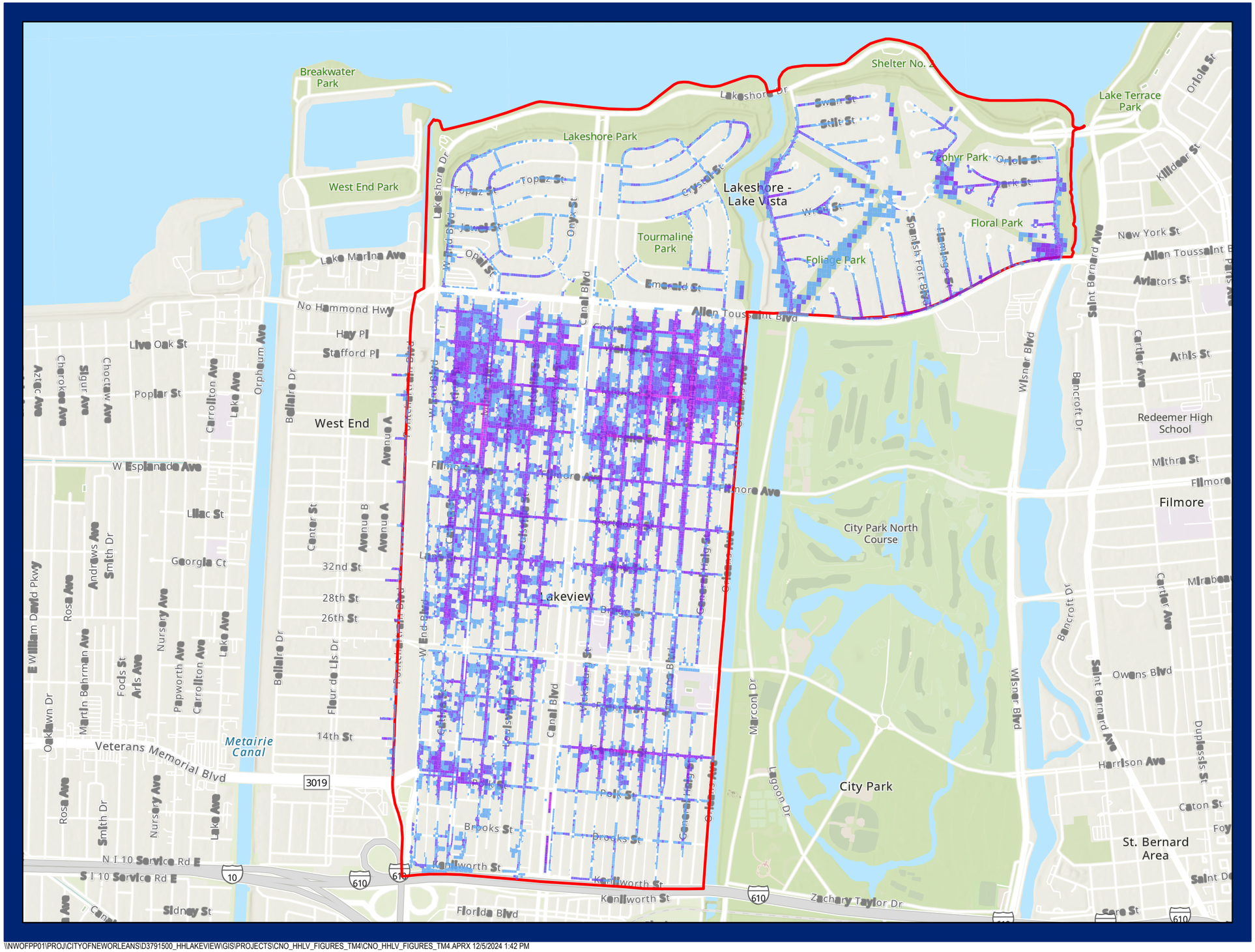
N

0 0.25 0.5 Miles

Figure F- 12
Concept 11 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

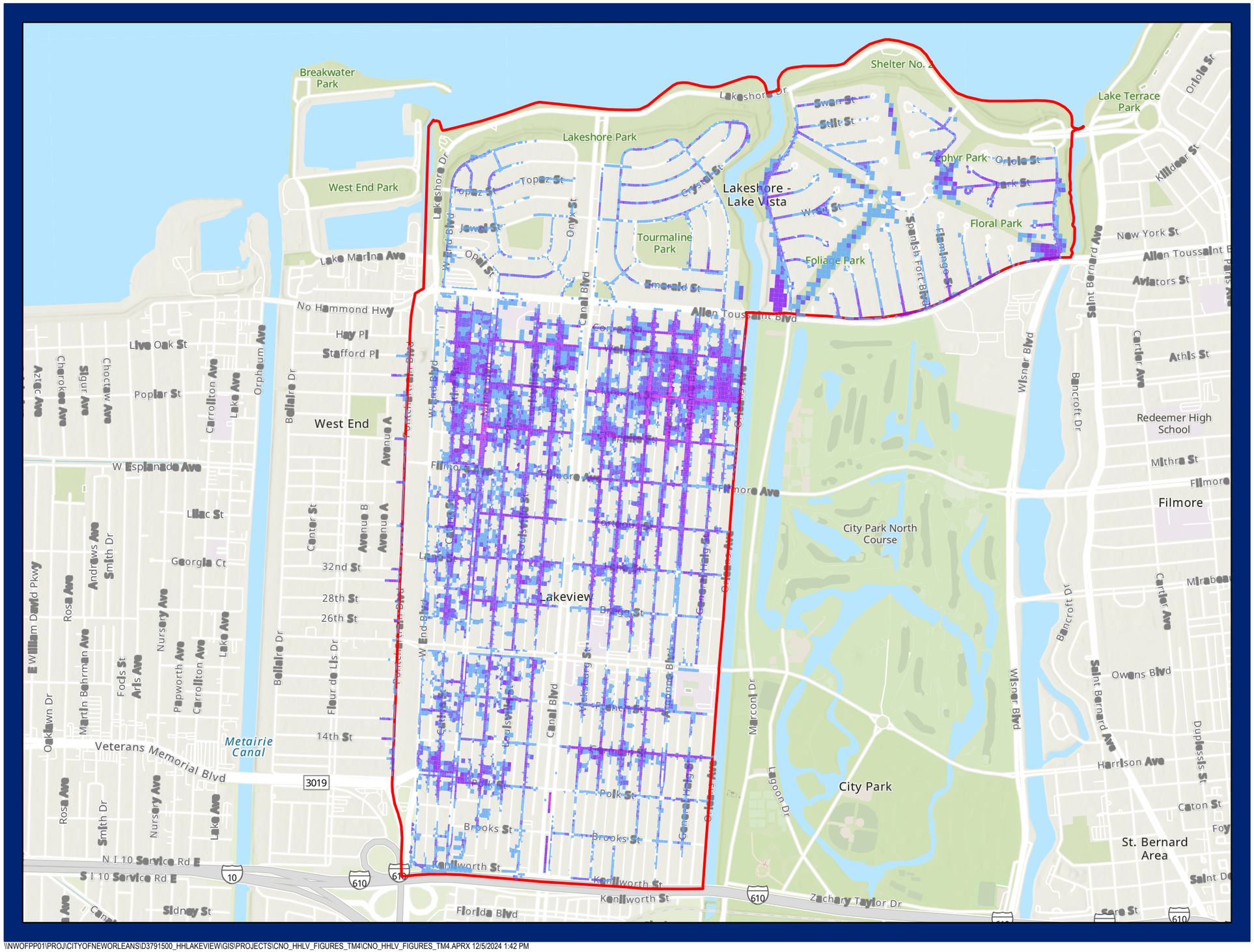
N

0 0.25 0.5 Miles

Figure F- 13
Concept 12 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM



LEGEND

Project Area

Concept Inundation Map

Maximum Depth [ft]

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 2
- 2 - 3
- > 3

N

0 0.25 0.5 Miles

Figure F- 14
Concept 13 Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

\\NWOFPP01\PROJ\CITYOFNEWORLEANS\D3791500_HHLAKEVIEW\GIS\PROJECTS\CNO_HHLV_FIGURES_TM4\CNO_HHLV_FIGURES_TM4.APRX 12/5/2024 1:42 PM

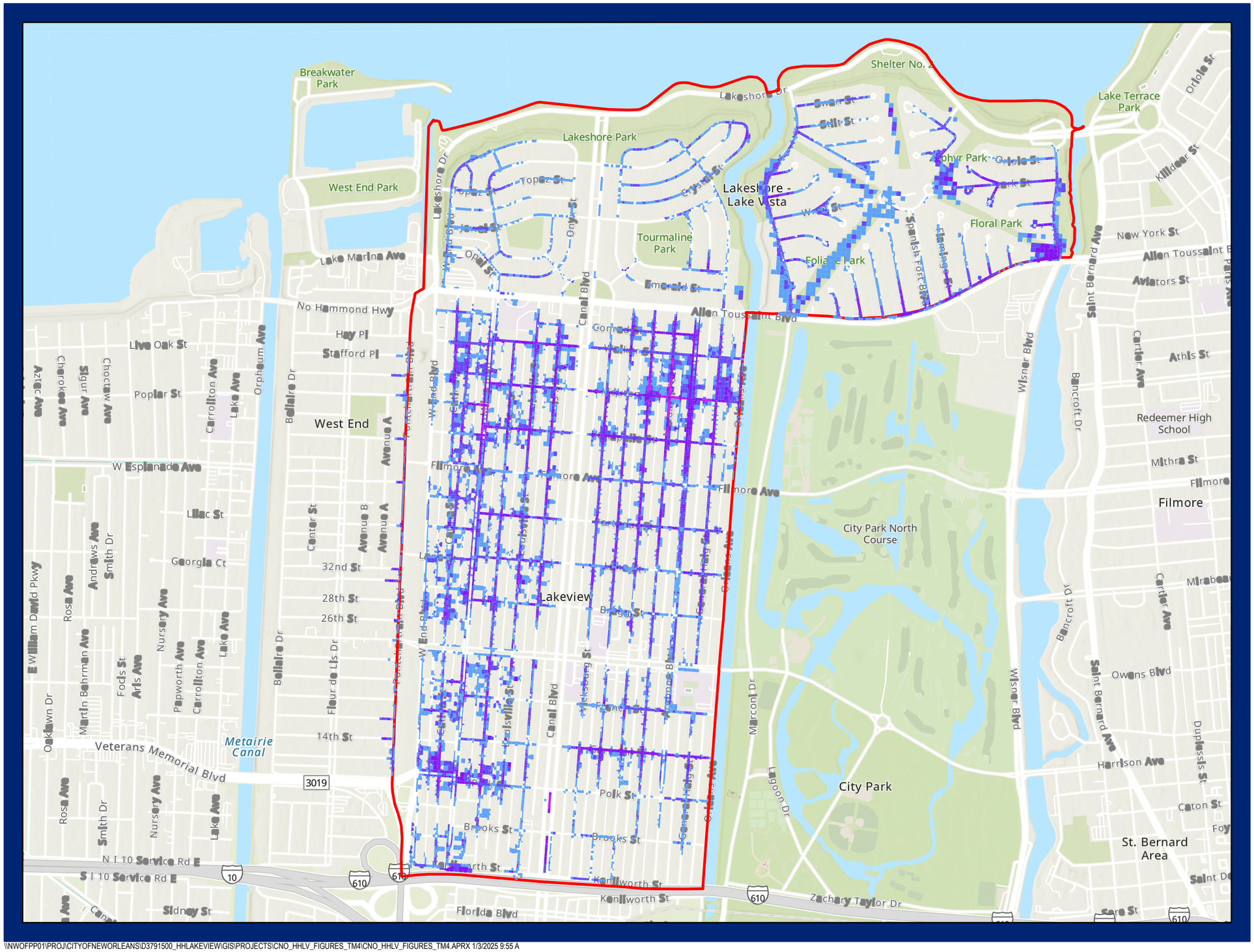


Figure F-14A
Concept 13 "Free Outfall" Inundation Map
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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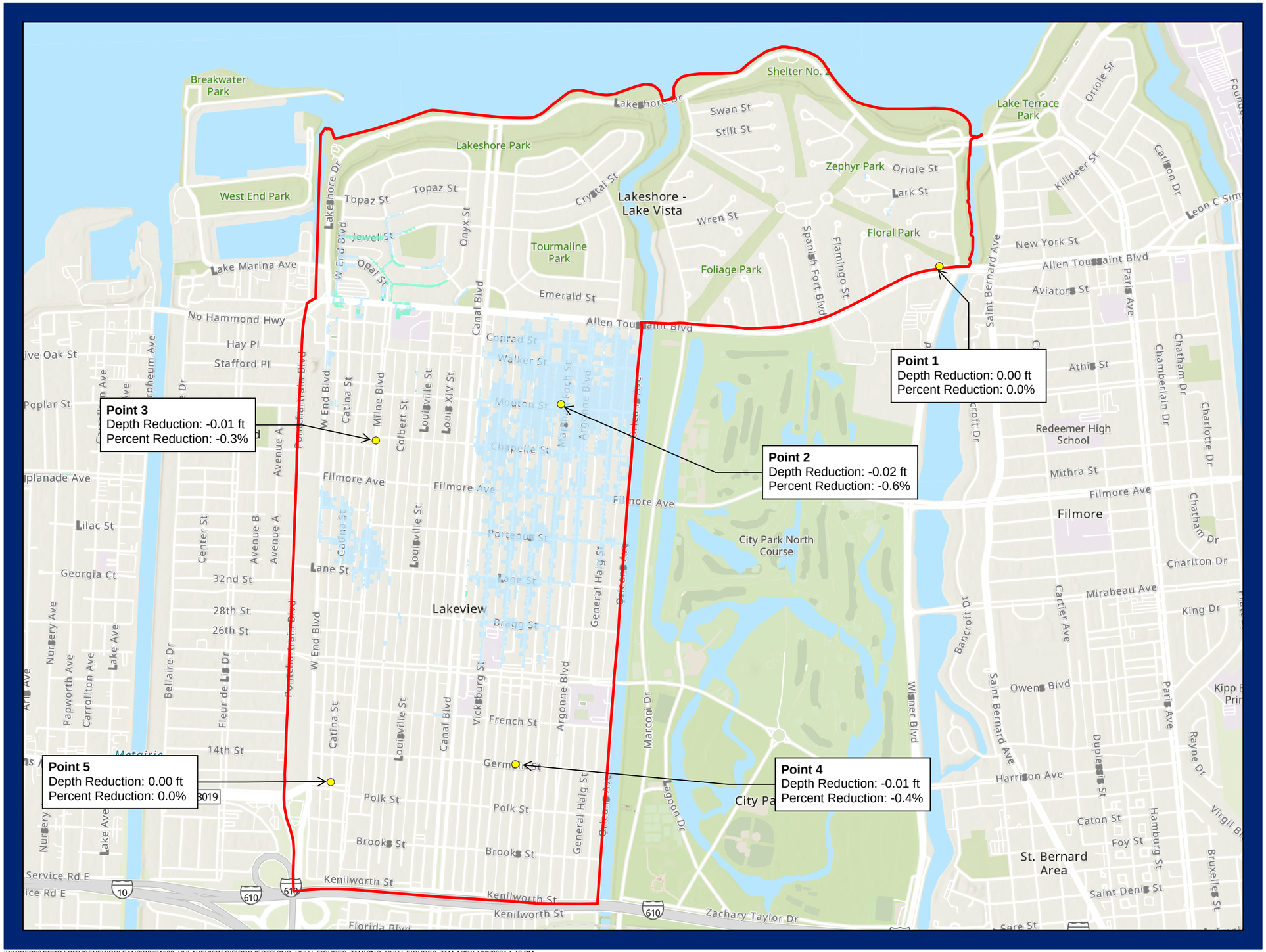
F.2 Flood Difference Maps



LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 15
Concept 1 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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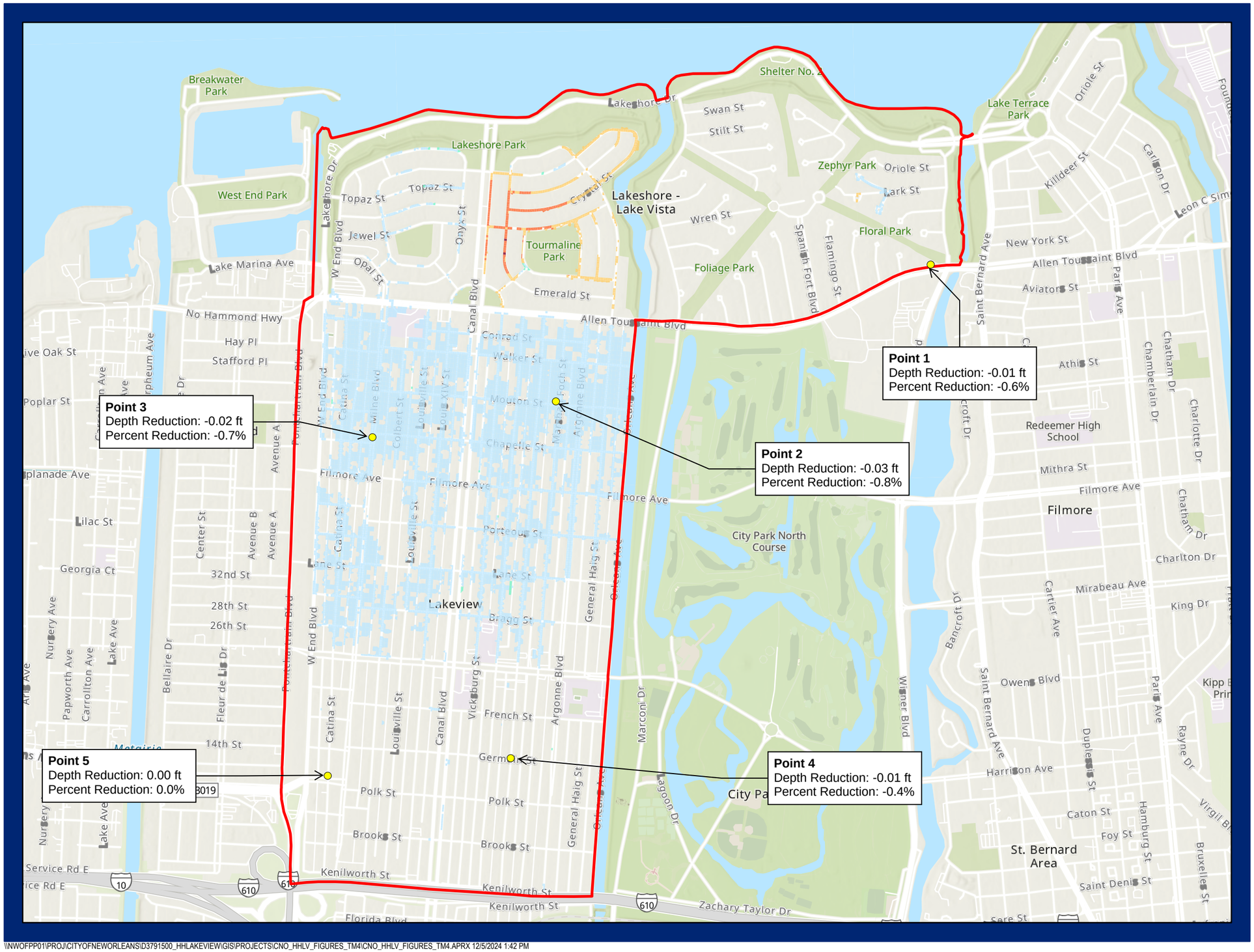

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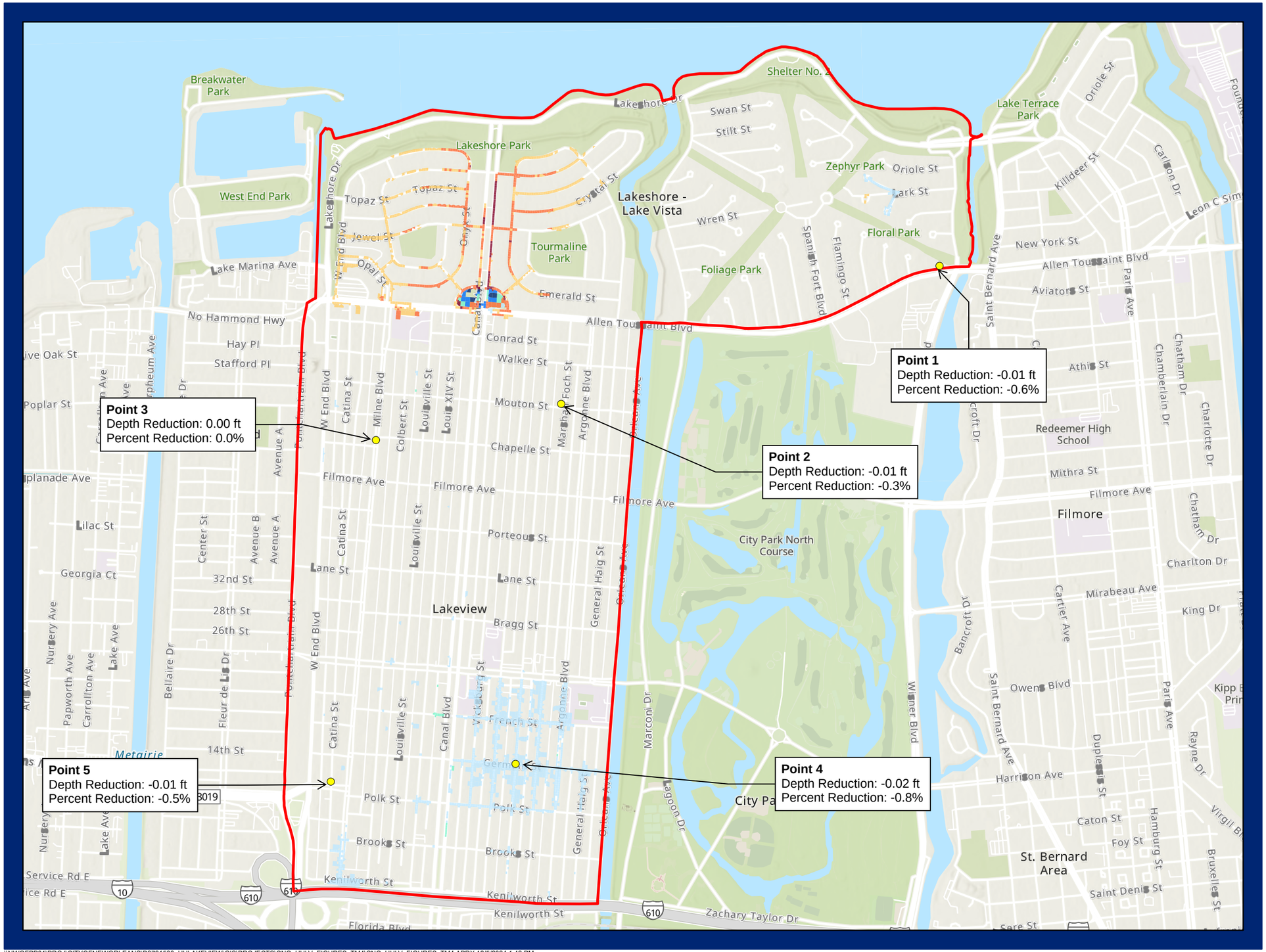
Figure F- 16
Concept 2 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs



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LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 17
Concept 3A Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

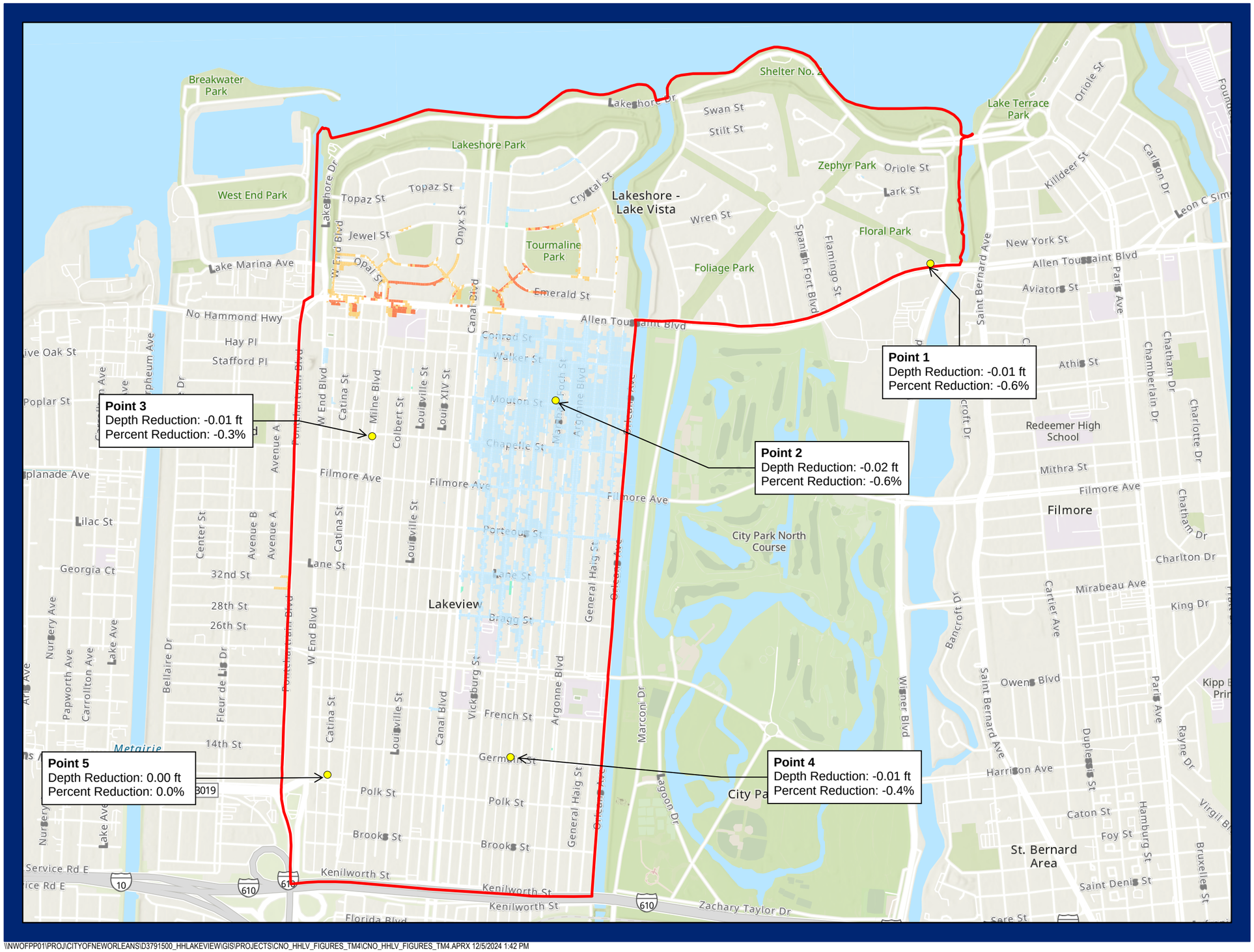

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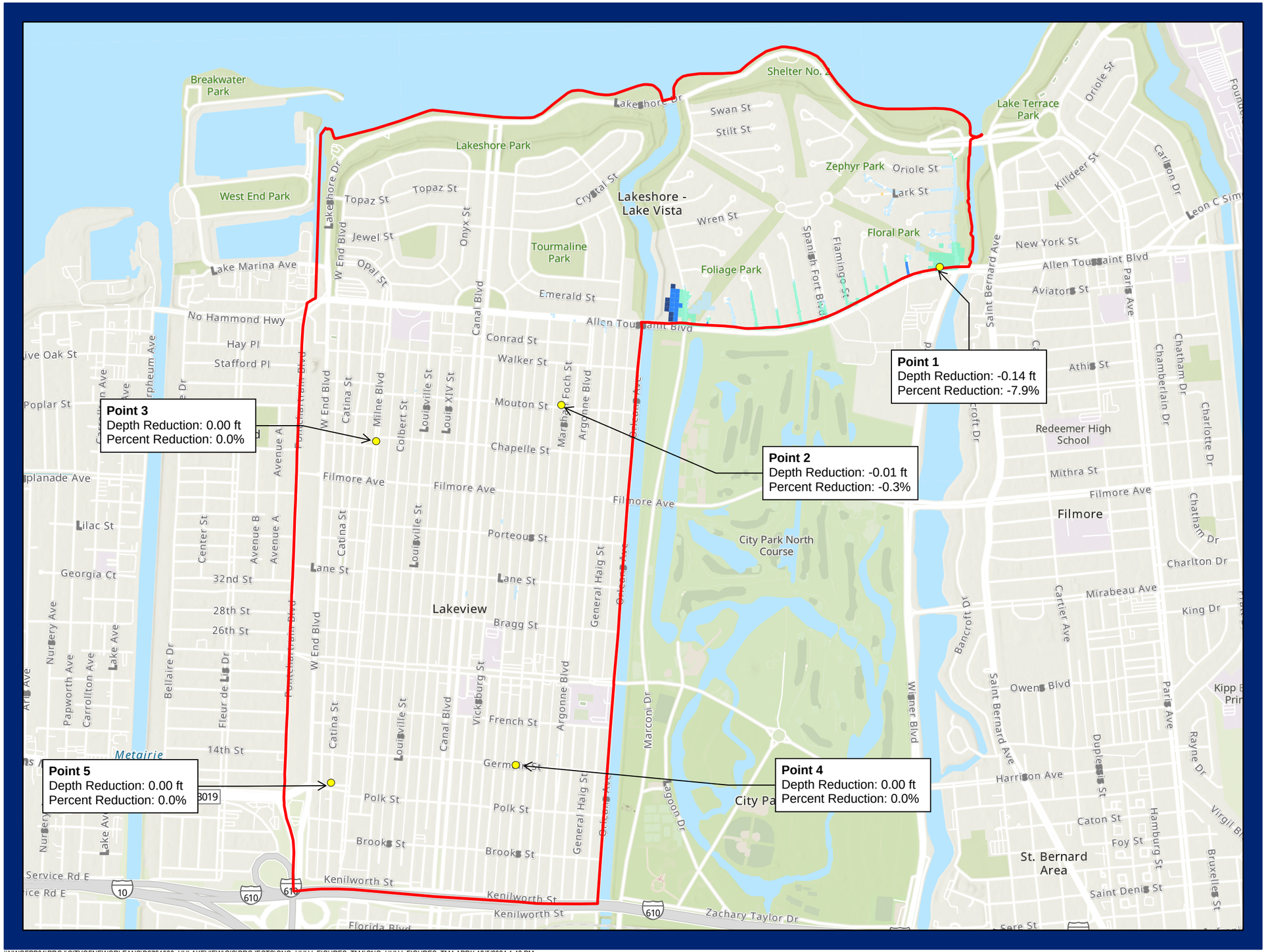
Figure F- 18
Concept 3B Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs



LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 19
Concept 4 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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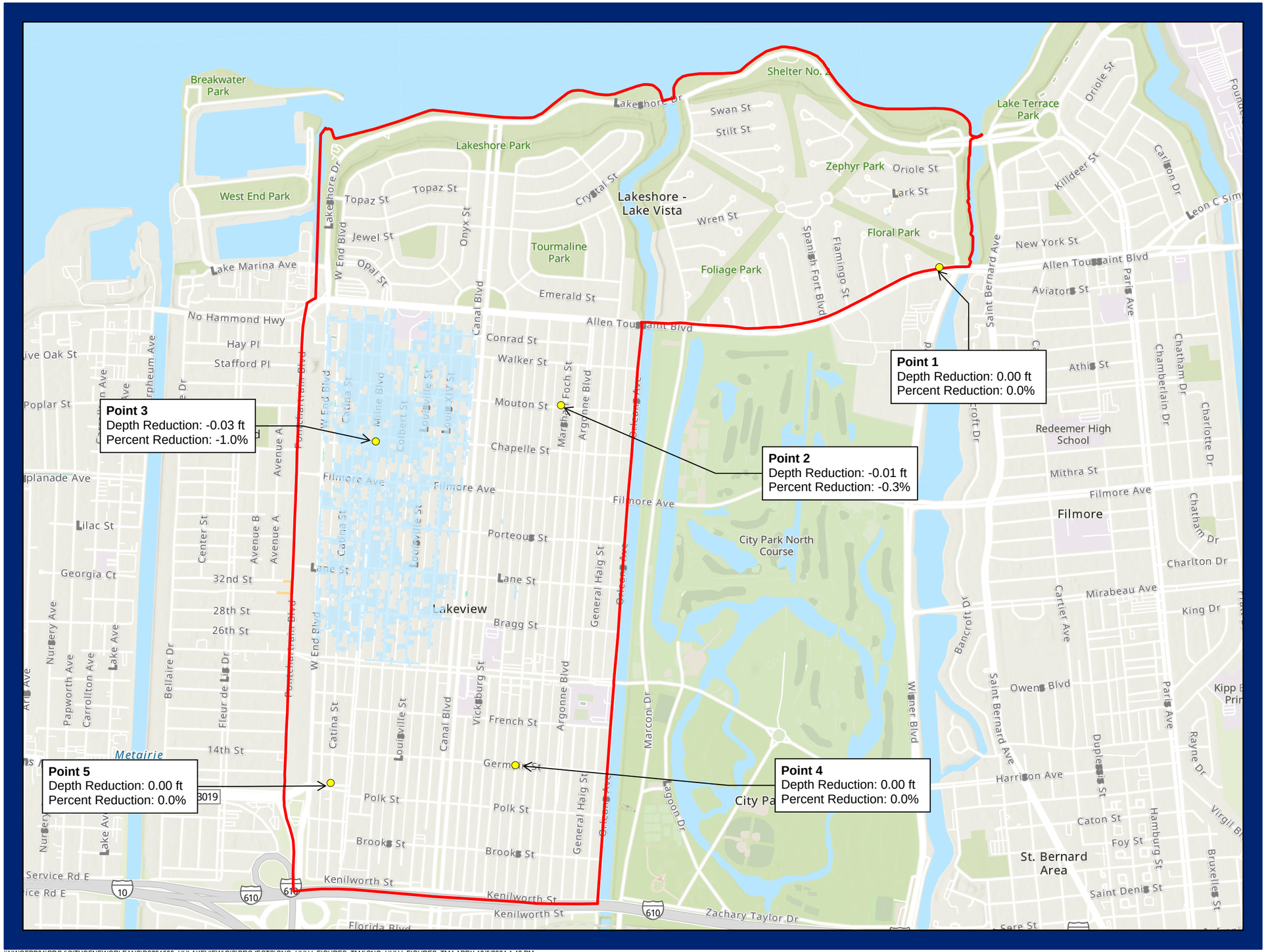

LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 20
Concept 5 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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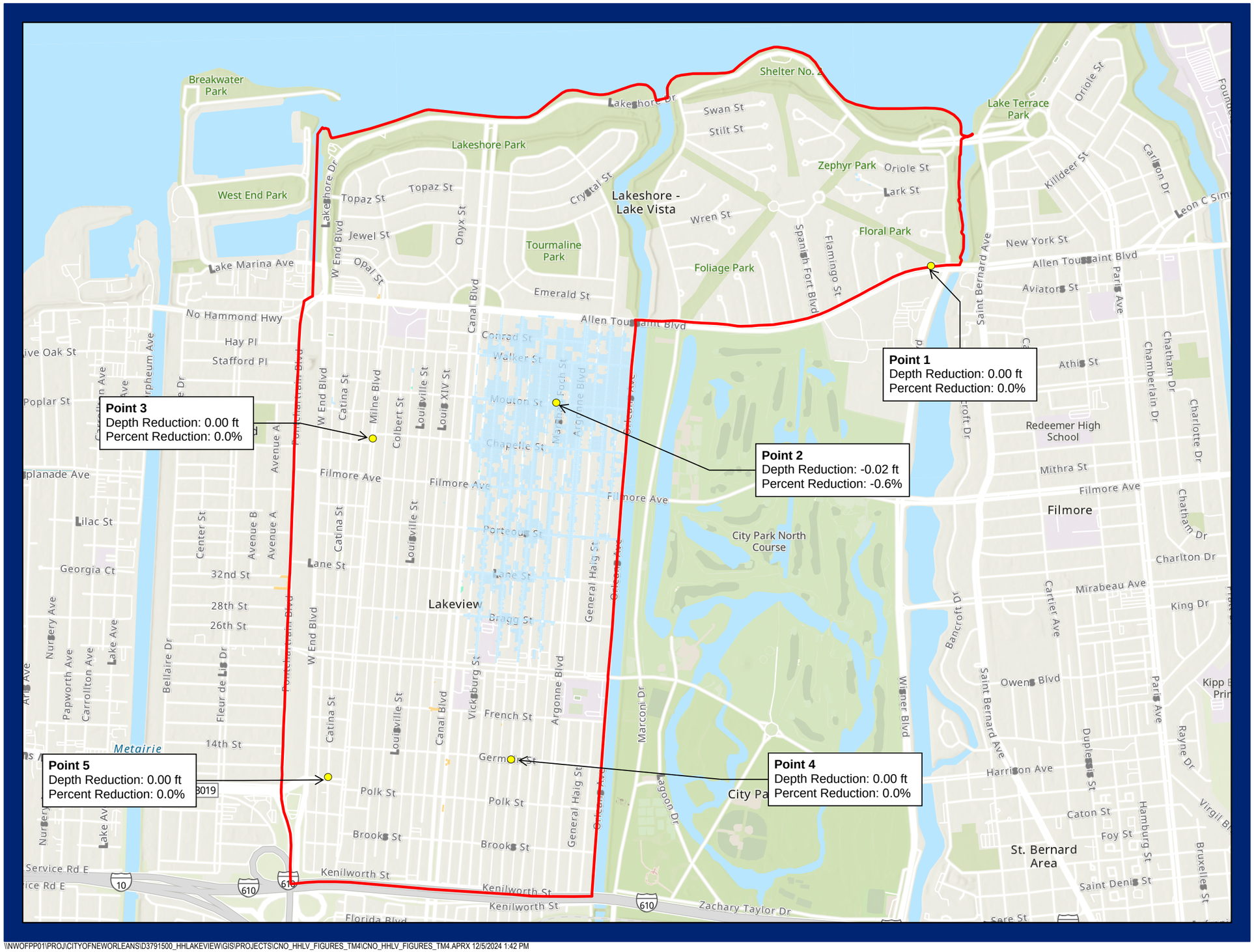

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LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 21
Concept 6 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 22
Concept 7 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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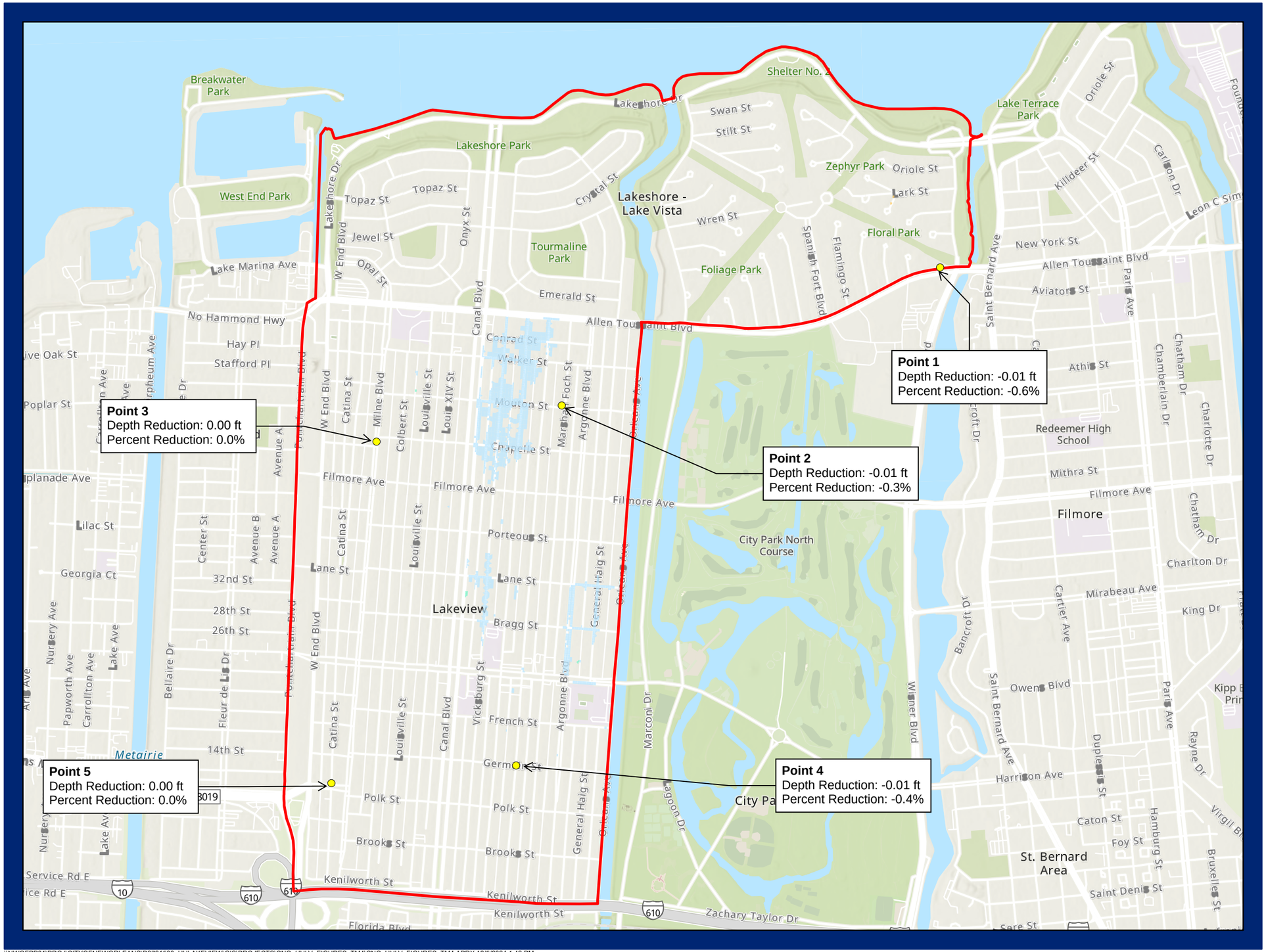

Figure F- 23
Concept 8 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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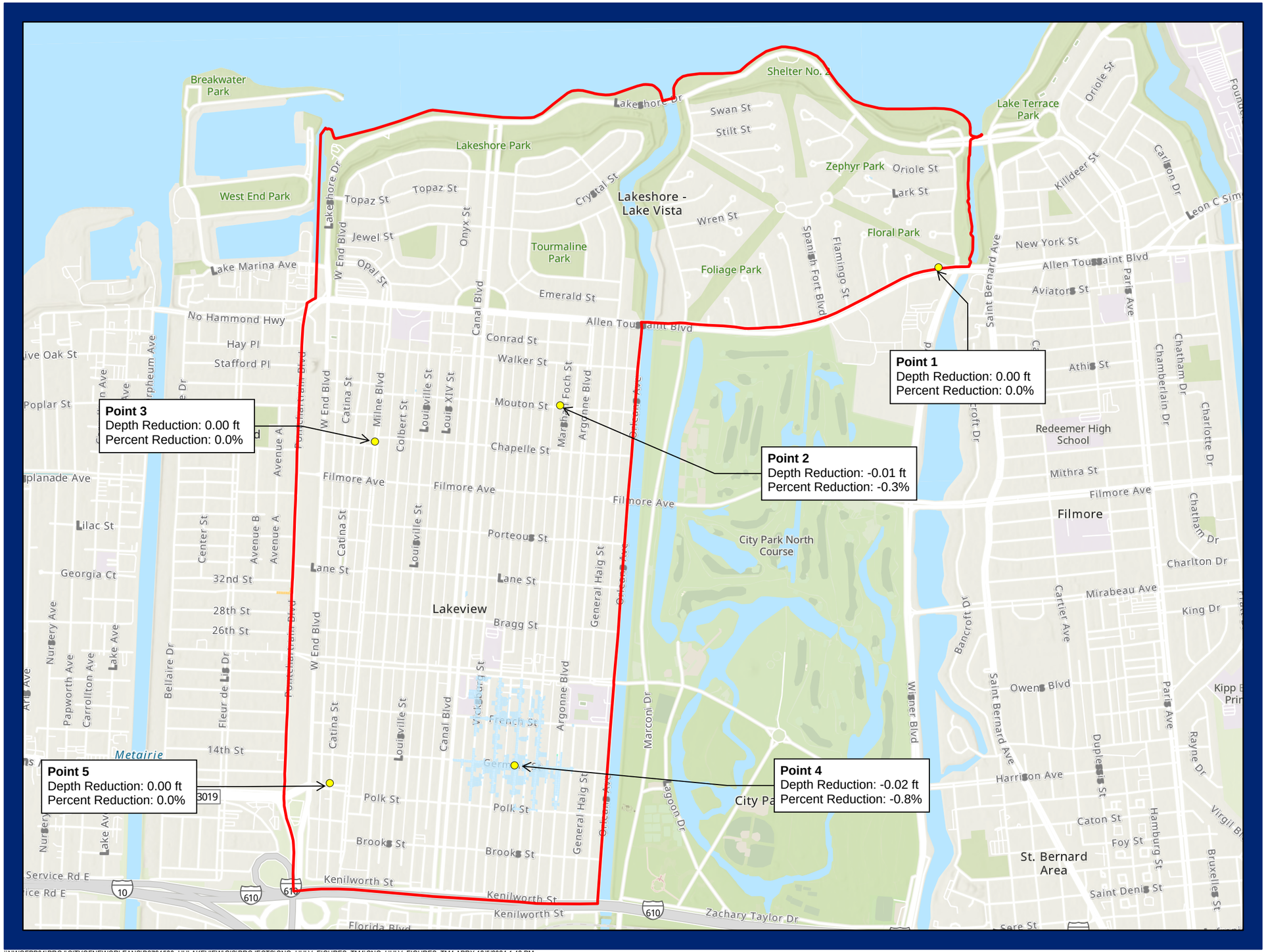

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LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 24
Concept 9 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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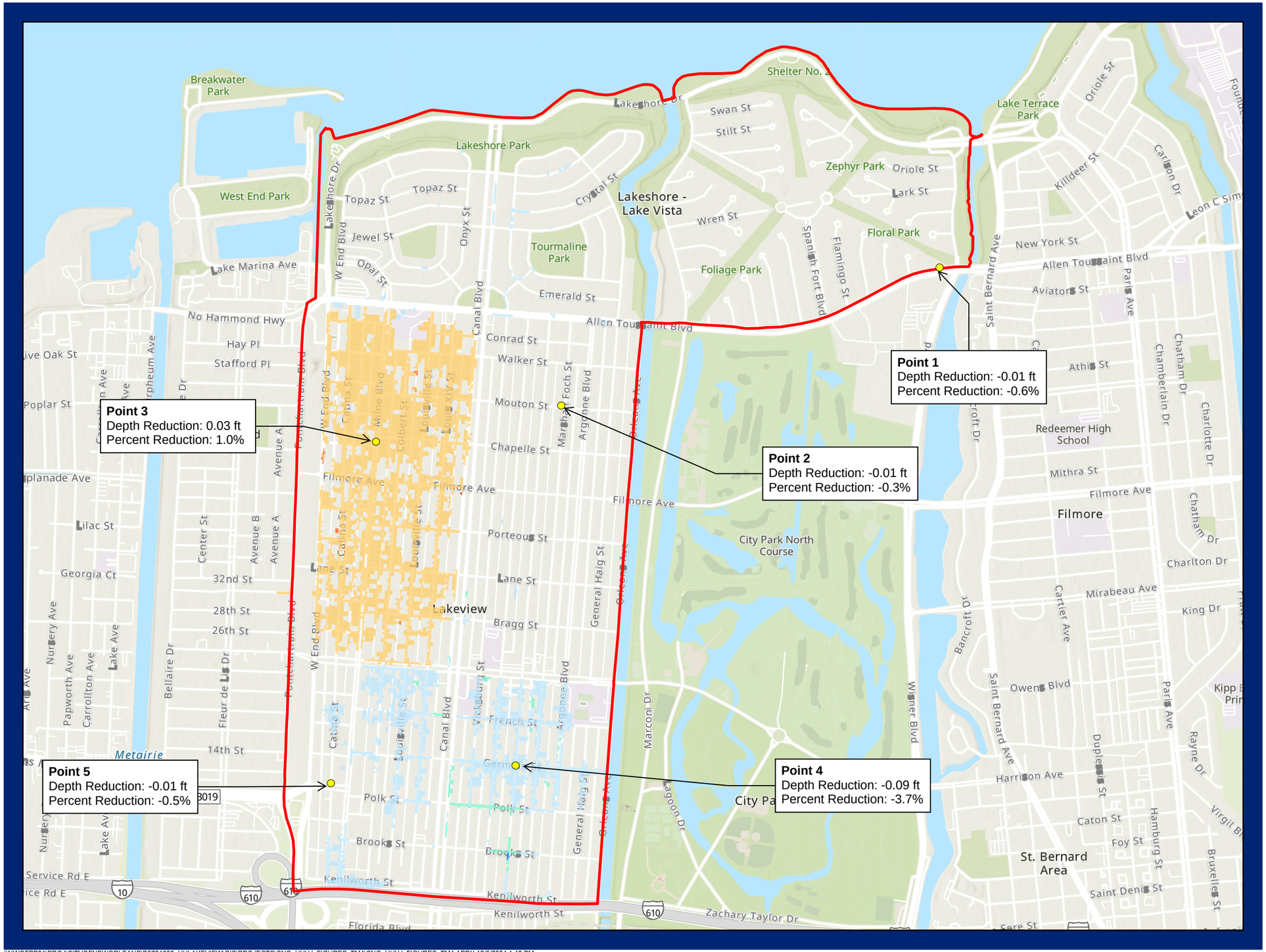

LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 25
Concept 10 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 26
Concept 11 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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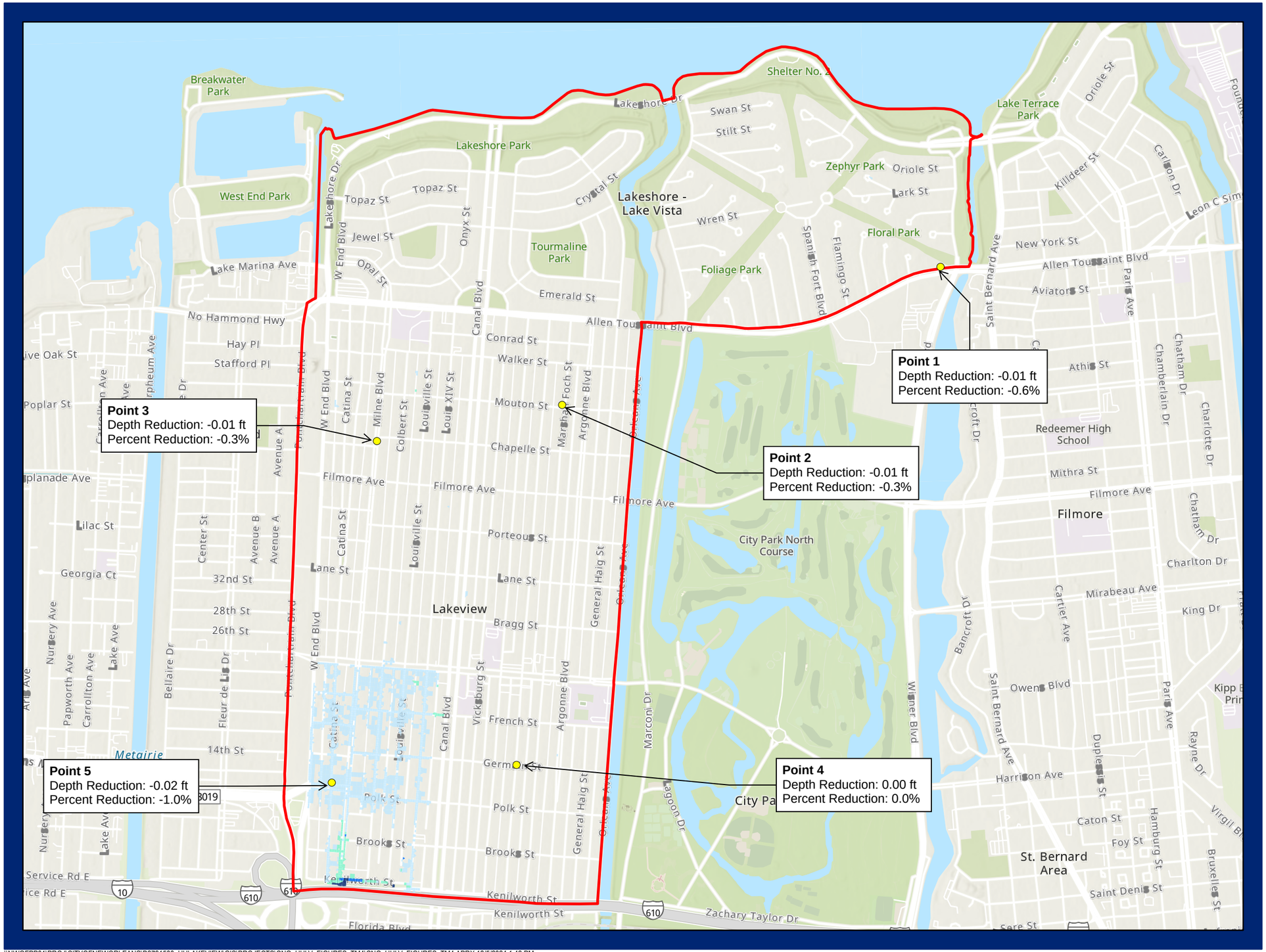

LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

Figure F- 27
Concept 12 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs

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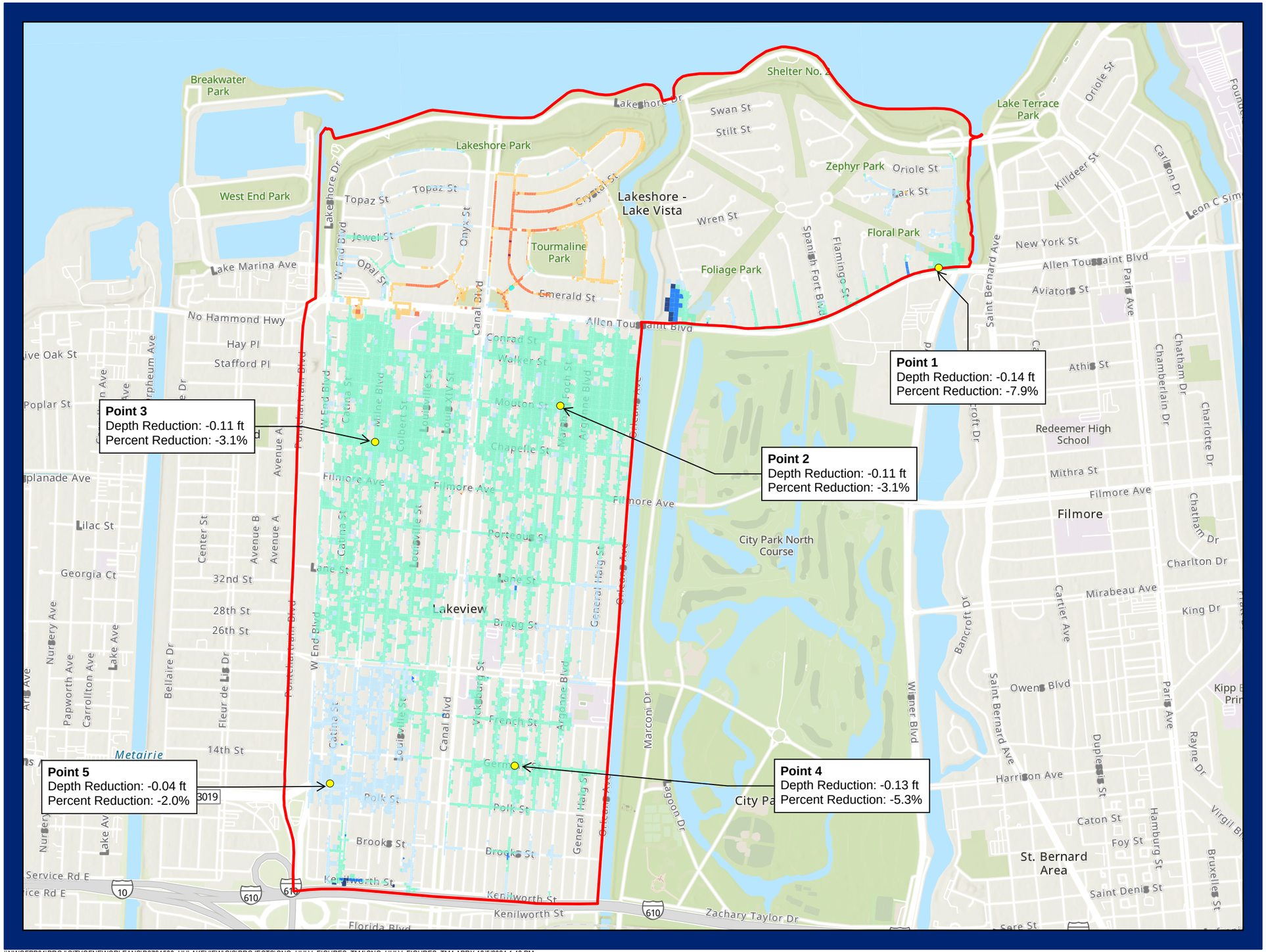

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LEGEND

Project Area

Water Surface Elevation Difference Map [ft]

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.1 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

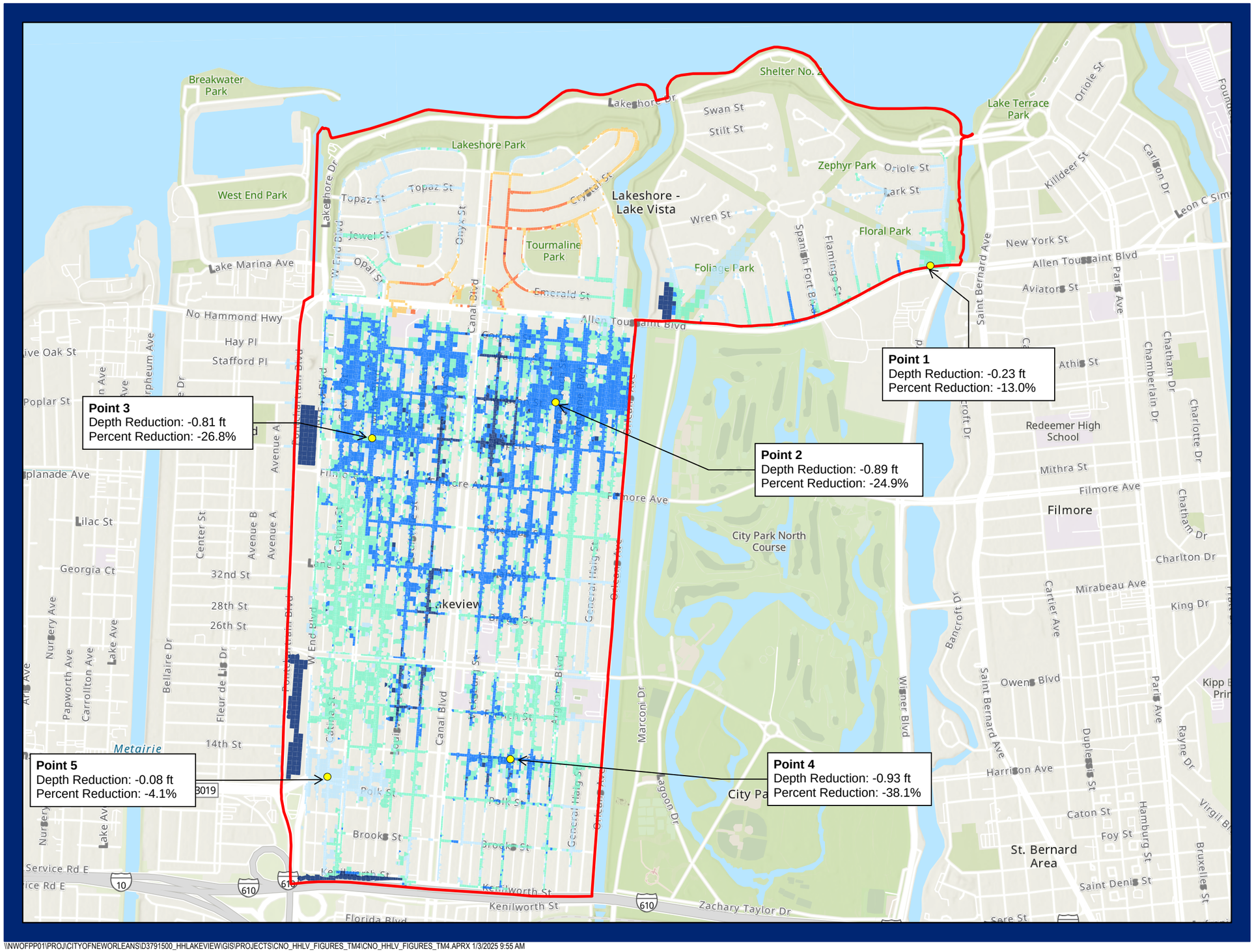
Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F- 28
Concept 13 Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

Jacobs



LEGEND

Project Area

Water Surface Elevation Difference Map (ft)

- < -1
- -1 - -0.5
- -0.5 - -0.1
- -0.01 - -0.01
- -0.01 - 0.01
- 0.01 - 0.1
- 0.1 - 0.5
- > 0.5

Negative values represent a decrease in WSE after a concept is applied

N

0 0.25 0.5 Miles

Figure F-28A
"Free Outfall" Scenario
Concept 13A Difference Map
Alternative Results - Existing Conditions
City of New Orleans Department of Public Works
Hydrologic and Hydraulic Study - Lakeview
New Orleans, Louisiana

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Appendix G. Cost Estimates

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 1
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	941.0	$ 36,228.50
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	18.0	$ 522.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	0.0	$ -
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	0.0	$ -
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	209.1	$ 12,232.35
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	313.7	$ 7,528.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	1176.3	$ 3,528.90
C203(60)	GEOGRID	SY	$ 4.00	941.0	$ 3,764.00
C302(51)	BASE COURSE	CY	$ 186.00	209.1	$ 38,892.60
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	0.0	$ -
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	0.0	$ -
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	941.0	$ 111,038.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	18.0	$ 1,710.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	340.0	$ 7,650.00
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	24.0	$ 120.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	600.0	$ 6,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	12.5	$ 518.75
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	12.5	$ 2,656.25
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	4.0	$ 800.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	7.0	$ 14,000.00
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	1.0	$ 30,000.00
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	12.0	$ 18,000.00

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 1
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	12.0	$ 24,000.00
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	107.0	$ 5,350.00
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	400.0	$ 116,200.00
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	330.0	$ 123,750.00
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	9629.6	$ 3,195,486.46
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 3,834,976.61
30%	Low Contingency				$ 2,684,483.63
50%	High Contingency				$ 5,752,464.92

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 2
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	994.0	$ 38,269.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	12.0	$ 348.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	0.0	$ -
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	0.0	$ -
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	220.9	$ 12,922.65
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	331.3	$ 7,951.20
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	1242.5	$ 3,727.50
C203(60)	GEOGRID	SY	$ 4.00	994.0	$ 3,976.00
C302(51)	BASE COURSE	CY	$ 186.00	220.9	$ 41,087.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	0.0	$ -
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	0.0	$ -
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	994.0	$ 117,292.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	12.0	$ 1,140.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	285.0	$ 6,412.50
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	16.0	$ 80.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	250.0	$ 2,500.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	25.0	$ 1,037.50
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	25.0	$ 5,312.50
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	12.0	$ 2,400.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	3.0	$ 6,000.00
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	1.0	$ 20,000.00
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	4.0	$ 6,000.00

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 2
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	1.0	$ 17,500.00
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	120.0	$ 34,860.00
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	404.0	$ 242,400.00
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	25925.9	$ 7,108,363.26
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 7,754,579.51
30%	Low Contingency				$ 5,428,205.66
50%	High Contingency				$ 11,631,869.27

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 3A
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	**DESCRIPTION OF ITEM**	**Unit**	**Unit Price**	**Qty.**	**Total Cost**
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	4000.0	$ 154,000.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	600.0	$ 17,400.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	1100.0	$ 7,700.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	3600.0	$ 135,000.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	1244.4	$ 72,797.40
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	1866.7	$ 44,800.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	7000.0	$ 21,000.00
C203(60)	GEOGRID	SY	$ 4.00	5600.0	$ 22,400.00
C302(51)	BASE COURSE	CY	$ 186.00	1244.4	$ 231,458.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	1600.0	$ 52,000.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	1600.0	$ 102,400.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	4000.0	$ 472,000.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	450.0	$ 42,750.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	150.0	$ 13,500.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	1750.0	$ 39,375.00
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	210.0	$ 13,020.00
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	400.0	$ 2,000.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	300.0	$ 3,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	162.5	$ 6,743.75
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	162.5	$ 34,531.25
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	22.2	$ 4,440.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	8.0	$ 16,000.00
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	1.0	$ 125,000.00
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 3A
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	97.0	$ 30,409.50
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	1179.0	$ 412,650.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	24.0	$ 14,400.00
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	2.0	$ 45,000.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	2843.0	$ 10,874,475.00
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	26370.4	$ 1,502,849.10
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 14,543,100.20
30%	Low Contingency				$ 10,180,170.14
50%	High Contingency				$ 21,814,650.30

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 3B
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	4000.0	$ 154,000.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	590.0	$ 17,110.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	1100.0	$ 7,700.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	2700.0	$ 101,250.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	1044.4	$ 61,097.40
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	1566.7	$ 37,600.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	5875.0	$ 17,625.00
C203(60)	GEOGRID	SY	$ 4.00	4700.0	$ 18,800.00
C302(51)	BASE COURSE	CY	$ 186.00	1044.4	$ 194,258.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	700.0	$ 22,750.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	700.0	$ 44,800.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	4000.0	$ 472,000.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	440.0	$ 41,800.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	150.0	$ 13,500.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	1750.0	$ 39,375.00
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	220.0	$ 13,640.00
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	400.0	$ 2,000.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	460.0	$ 4,600.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	62.5	$ 2,593.75
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	62.5	$ 13,281.25
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	22.2	$ 4,440.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	8.0	$ 16,000.00
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	1.0	$ 125,000.00
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	40.0	$ 60,000.00

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 3B
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	198.0	$ 67,320.00
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	61.0	$ 17,720.50
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	16.0	$ 5,016.00
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	225.0	$ 78,750.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	2.0	$ 45,000.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	2.0	$ 60,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	20740.7	$ 1,182,012.49
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 3,088,050.79
30%	Low Contingency				$ 2,161,635.55
50%	High Contingency				$ 4,632,076.19

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 4
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	47.0	$ 1,809.50
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	8.0	$ 232.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	0.0	$ -
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	0.0	$ -
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	10.4	$ 608.40
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	15.7	$ 376.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	58.8	$ 176.40
C203(60)	GEOGRID	SY	$ 4.00	47.0	$ 188.00
C302(51)	BASE COURSE	CY	$ 186.00	10.4	$ 1,934.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	45.0	$ 1,462.50
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	0.0	$ -
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	47.0	$ 5,546.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	8.0	$ 760.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	30.0	$ 675.00
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	10.0	$ 50.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	50.0	$ 500.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	0.0	$ -
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	0.0	$ -
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	0.0	$ -
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	1.0	$ 35,000.00
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 4
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	1.0	$ 17,500.00
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	120.0	$ 84,000.00
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	19259.3	$ 1,113,765.32
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 1,339,584.32
30%	Low Contingency				$ 937,709.02
50%	High Contingency				$ 2,009,376.48

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 5
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	1850.0	$ 71,225.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	40.0	$ 1,160.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	0.0	$ -
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	0.0	$ -
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	411.1	$ 24,049.35
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	616.7	$ 14,800.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	2312.5	$ 6,937.50
C203(60)	GEOGRID	SY	$ 4.00	1850.0	$ 7,400.00
C302(51)	BASE COURSE	CY	$ 186.00	411.1	$ 76,464.60
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	0.0	$ -
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	0.0	$ -
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	1850.0	$ 218,300.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	40.0	$ 3,800.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	1330.0	$ 29,925.00
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	60.0	$ 1,500.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	0.0	$ -
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	40.0	$ 200.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	3000.0	$ 30,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	0.0	$ -
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	0.0	$ -
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	0.0	$ -
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	1.0	$ 75,000.00
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 5
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	32.0	$ 64,000.00
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	1.0	$ 17,500.00
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	80.0	$ 23,240.00
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	1610.0	$ 563,500.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	44259.3	$ 3,161,441.80
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 4,465,444.05
30%	Low Contingency				$ 3,125,810.84
50%	High Contingency				$ 6,698,166.08

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 6
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	767.0	$ 29,529.50
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	1450.0	$ 42,050.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	2200.0	$ 15,400.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	3600.0	$ 135,000.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	970.4	$ 56,768.40
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	1455.7	$ 34,936.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	5458.8	$ 16,376.40
C203(60)	GEOGRID	SY	$ 4.00	4367.0	$ 17,468.00
C302(51)	BASE COURSE	CY	$ 186.00	970.4	$ 180,494.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	3600.0	$ 117,000.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	3600.0	$ 230,400.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	767.0	$ 90,506.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	1000.0	$ 95,000.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	450.0	$ 40,500.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	0.0	$ -
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	2200.0	$ 114,400.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	100.0	$ 500.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	320.0	$ 3,200.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	250.0	$ 10,375.00
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	250.0	$ 53,125.00
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	80.0	$ 16,000.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	20.0	$ 40,000.00
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	1.0	$ 20,000.00
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	24.0	$ 36,000.00

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 6
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	16.0	$ 80,000.00
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	320.0	$ 108,800.00
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	100.0	$ 29,050.00
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	1255.0	$ 393,442.50
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	2.0	$ 45,000.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	2.0	$ 45,000.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	2.0	$ 60,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	1527.8	$ 614,679.77
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	441.9	$ 202,279.73
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 2,973,281.50
30%	Low Contingency				$ 2,081,297.05
50%	High Contingency				$ 4,459,922.25

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 7
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	6377.5	$ 245,533.75
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	92.0	$ 2,668.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	270.0	$ 1,890.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	330.0	$ 12,375.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	97.8	$ 5,721.30
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	146.7	$ 3,520.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	550.0	$ 1,650.00
C203(60)	GEOGRID	SY	$ 4.00	440.0	$ 1,760.00
C302(51)	BASE COURSE	CY	$ 186.00	97.8	$ 18,190.80
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	330.0	$ 10,725.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	330.0	$ 21,120.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	110.0	$ 12,980.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	92.0	$ 8,740.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	0.0	$ -
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	60.0	$ 1,500.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	120.0	$ 6,240.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	150.0	$ 9,300.00
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	80.0	$ 400.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	600.0	$ 6,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	0.0	$ -
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	0.0	$ -
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	0.0	$ -
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	1.0	$ 50,000.00
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				
DPW Proj. No.:	DPW724			Concept 7	
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	9.0	$ 157,500.00
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	1410.0	$ 2,397,000.00
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	1440.0	$ 3,456,000.00
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	0.0	$ -
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	11718.9	$ 2,468,820.66
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	6267.5	$ 1,253,500.00
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 10,153,135.31
30%	Low Contingency				$ 7,107,194.72
50%	High Contingency				$ 15,229,702.97

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 8
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	1966.0	$ 75,691.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	1339.0	$ 38,831.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	40.0	$ 280.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	40.0	$ 1,500.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	445.8	$ 26,079.30
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	668.7	$ 16,048.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	2507.5	$ 7,522.50
C203(60)	GEOGRID	SY	$ 4.00	2006.0	$ 8,024.00
C302(51)	BASE COURSE	CY	$ 186.00	445.8	$ 82,918.80
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	56.0	$ 16,800.00
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	70.0	$ 2,275.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	40.0	$ 2,560.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	1966.0	$ 231,988.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	157.0	$ 14,915.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	1182.0	$ 106,380.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	85.0	$ 1,912.50
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	685.0	$ 17,125.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	40.0	$ 2,080.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	100.0	$ 500.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	200.0	$ 2,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	0.0	$ -
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	0.0	$ -
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	0.0	$ -
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	1.0	$ 10,000.00
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	4.0	$ 6,000.00

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 8
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	12.0	$ 24,000.00
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	140.0	$ 43,890.00
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	450.0	$ 157,500.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	4731.6	$ 1,283,020.66
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	13555.6	$ 3,336,575.38
	GREEN ROOF -008C	CY	$ 1,261.94	816.0	$ 1,029,743.04
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 6,621,159.98
30%	Low Contingency				$ 4,634,811.99
50%	High Contingency				$ 9,931,739.97

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 9
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	565.0	$ 21,752.50
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	360.0	$ 10,440.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	510.0	$ 3,570.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	2200.0	$ 82,500.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	614.4	$ 35,942.40
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	921.7	$ 22,120.80
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	3456.3	$ 10,368.90
C203(60)	GEOGRID	SY	$ 4.00	2765.0	$ 11,060.00
C302(51)	BASE COURSE	CY	$ 186.00	614.4	$ 114,278.40
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	56.0	$ 16,800.00
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	2200.0	$ 71,500.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	2200.0	$ 140,800.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	565.0	$ 66,670.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	240.0	$ 22,800.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	120.0	$ 10,800.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	45.0	$ 1,012.50
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	65.0	$ 1,625.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	510.0	$ 26,520.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	100.0	$ 500.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	2700.0	$ 27,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	100.0	$ 4,150.00
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	100.0	$ 21,250.00
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	31.1	$ 6,220.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	1.0	$ 15,000.00
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 9
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	56.0	$ 112,000.00
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	4.0	$ 20,000.00
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	140.0	$ 47,600.00
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	101.0	$ 31,663.50
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	1563.0	$ 547,050.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	3259.3	$ 742,175.20
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 2,320,169.20
30%	Low Contingency				$ 1,624,118.44
50%	High Contingency				$ 3,480,253.80

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 10
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	1000.0	$ 38,500.00
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	3360.0	$ 97,440.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	6900.0	$ 48,300.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	11695.0	$ 438,562.50
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	2821.1	$ 165,034.35
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	3898.3	$ 93,559.20
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	104368.8	$ 313,106.40
C203(60)	GEOGRID	SY	$ 4.00	38036.8	$ 152,147.20
C302(51)	BASE COURSE	CY	$ 186.00	8452.6	$ 1,572,183.60
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	11695.0	$ 380,087.50
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	11695.0	$ 748,480.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	1000.0	$ 118,000.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	2760.0	$ 262,200.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	600.0	$ 54,000.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	0.0	$ -
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	100.0	$ 2,500.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	6140.0	$ 319,280.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	760.0	$ 47,120.00
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	1500.0	$ 7,500.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	1200.0	$ 12,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	375.0	$ 15,562.50
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	375.0	$ 79,687.50
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	124.3	$ 24,860.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	1.0	$ 250,000.00
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				
DPW Proj. No.:	DPW724			Concept 10	
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	0.0	$ -
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	0.0	$ -
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	71114.4	$ 3,200,148.00
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	4689.0	$ 46,890,000.00
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	20652.8	$ 4,956,672.00
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	3.0	$ 37,500.00
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	38.0	$ 475,000.00
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	1.0	$ 17,250.00
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	6.0	$ 150,000.00
TOTAL ESTIMATED COSTS					$ 60,966,680.75
30%	Low Contingency				$ 42,676,676.53
50%	High Contingency				$ 91,450,021.13

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 11
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	563.0	$ 21,675.50
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	370.0	$ 10,730.00
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	548.0	$ 3,836.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	2500.0	$ 93,750.00
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	680.7	$ 39,820.95
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	1021.0	$ 24,504.00
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	3828.8	$ 11,486.40
C203(60)	GEOGRID	SY	$ 4.00	3063.0	$ 12,252.00
C302(51)	BASE COURSE	CY	$ 186.00	680.7	$ 126,610.20
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	2500.0	$ 81,250.00
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	2500.0	$ 160,000.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	563.0	$ 66,434.00
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	250.0	$ 23,750.00
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	120.0	$ 10,800.00
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	0.0	$ -
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	95.0	$ 2,375.00
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	500.0	$ 26,000.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	48.0	$ 2,976.00
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	50.0	$ 250.00
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	300.0	$ 3,000.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	112.5	$ 4,668.75
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	112.5	$ 23,906.25
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	35.5	$ 7,100.00
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	1.0	$ 125,000.00
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	0.0	$ -
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				
DPW Proj. No.:	DPW724				Concept 11
DPW PW No.:	D3791500				
Std. Spec.	**DESCRIPTION OF ITEM**	**Unit**	**Unit Price**	**Qty.**	**Total Cost**
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	6.0	$ 105,000.00
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	4.0	$ 20,000.00
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	50.0	$ 17,000.00
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	55.0	$ 19,250.00
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	1398.0	$ 838,800.00
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	0.0	$ -
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	84431.1	$ 5,206,021.63
	STORMWATER PARK - 012	CY	$ 59.57	0.0	$ -
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 7,110,746.68
30%	Low Contingency				$ 4,977,522.68
50%	High Contingency				$ 10,666,120.02

CNO H Drainage Study

Concept Cost Estimates

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S	Concept 12
DPW Proj. No.:	DPW724	
DPW PW No.:	D3791500	

Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C202(52)(C)	REMOVAL AND DISPOSAL OF EXISTING PORTLAND CEMENT CONCRETE PAVEMENT	SY	$ 38.50	0.0	$ -
C202(52)(D)	REMOVAL AND DISPOSAL OF EXISTING SIDEWALK, DRIVEWAY, FOOT LAP (CONCRETE, BRICK, ASPHALT, ETC.)	SY	$ 29.00	0.0	$ -
C202(52)(F)	REMOVAL AND DISPOSAL OF EXISTING CURB AND GUTTER BOTTOM	LF	$ 7.00	30.0	$ 210.00
C202(52)(I)	REMOVAL AND DISPOSAL OF EXISTING ASPHALTIC CONCRETE PAVEMENT	SY	$ 37.50	25.0	$ 937.50
C203(51)	ROADWAY EXCAVATION	CY	$ 58.50	5.6	$ 327.60
C203(58)	UNSUITABLE SUBGRADE EXCAVATION AND SAND FILLING	CY	$ 24.00	8.3	$ 199.20
C203(59)	GEOTEXTILE FABRIC FOR STABILIZATION	SY	$ 3.00	31.3	$ 93.90
C203(60)	GEOGRID	SY	$ 4.00	25.0	$ 100.00
C302(51)	BASE COURSE	CY	$ 186.00	5.6	$ 1,041.60
DR-11	INSTALL BRICKWORK PAVERS FOR ROADWAY RESTORATION	SY	$ 300.00	0.0	$ -
C502(53)-1	2" THICK SUPERPAVE ASPHALTIC CONCRETE WEARING COURSE	SY	$ 32.50	25.0	$ 812.50
C502(53)-2	5" THICK SUPERPAVE ASPHALTIC CONCRETE BINDER COURSE	SY	$ 64.00	25.0	$ 1,600.00
C509(51)	COLD PLANING ASPHALTIC PAVEMENT (2.0" AVERAGE THICK)	SY	$ 23.00	0.0	$ -
C601(54)	REINFORCED CONCRETE PAVEMENT (8" THICK)	SY	$ 118.00	0.0	$ -
C706(51)	CONCRETE SIDEWALK (4" THICK)	SY	$ 95.00	0.0	$ -
C706(52)	CONCRETE DRIVEWAY (6" THICK)	SY	$ 90.00	0.0	$ -
C707(55)	CONCRETE MOUNTABLE CURB WITH DOWELS	LF	$ 22.50	0.0	$ -
C707(56)	6" CONCRETE BARRIER CURB WITH DOWELS	LF	$ 25.00	0.0	$ -
C707(59)	CONCRETE MOUNTABLE CURB AND GUTTER BOTTOM	LF	$ 52.00	30.0	$ 1,560.00
C707(60)	6" CONCRETE BARRIER CURB & GUTTERBOTTOM OR ROLLING STRIP	LF	$ 62.00	0.0	$ -
CF-3	SIDEWALK, DRIVEWAY AND CURB SAW CUTTING	LF	$ 5.00	0.0	$ -
CF-4	PAVEMENT SAW CUTTING ADJACENT TO EXISTING PAVEMENT AND AT PATCHES AND UTILITY TRENCHES	LF	$ 10.00	50.0	$ 500.00
CF-5	REMOVAL OF HANDICAP RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS INCLUDING SAW CUTTING	SY	$ 41.50	0.0	$ -
CF-6	ADA-ACCESSIBLE CURB RAMPS, CURB AND GUTTER, AND CONCRETE SIDEWALKS AT INTERSECTIONS	SY	$ 212.50	0.0	$ -
CF-13	SIDEWALK TRANSITION ADJACENT TO ADA RAMPS	SY	$ 200.00	0.0	$ -
CF-375	MANHOLE REPAIR OR VERTICAL ADJUSTMENT UP TO 6" REUSING EXISTING METAL CASTINGS	EA	$ 2,000.00	0.0	$ -
CF-376	MANHOLE REPAIR OR VERTICAL ADJUSTMENT OVER 6" REUSING EXISTING METAL CASTINGS	FTHT	$ 750.00	0.0	$ -
C719(57)-X01	TREE REMOVAL 001	LS	$ 30,000.00	0.0	$ -
C719(57)-X02	TREE REMOVAL 002	LS	$ 20,000.00	0.0	$ -
C719(57)-X03	TREE REMOVAL 003	LS	$ 125,000.00	0.0	$ -
C719(57)-X04	TREE REMOVAL 004	LS	$ 35,000.00	0.0	$ -
C719(57)-X05	TREE REMOVAL 005	LS	$ 75,000.00	0.0	$ -
C719(57)-X06	TREE REMOVAL 006	LS	$ 20,000.00	0.0	$ -
C719(57)-X07A	TREE REMOVAL 007A	LS	$ 50,000.00	0.0	$ -
C719(57)-X08	TREE REMOVAL 008	LS	$ 10,000.00	0.0	$ -
C719(57)-X10	TREE REMOVAL 010	LS	$ 250,000.00	0.0	$ -
C719(57)-X11	TREE REMOVAL 011	LS	$ 125,000.00	0.0	$ -
C719(57)-X12	TREE REMOVAL 012	LS	$ 20,000.00	1.0	$ 20,000.00
C719(57)-X09	TREE REMOVAL 009	LS	$ 15,000.00	0.0	$ -
C702(52)(J)	NO. 1 STANDARD DRAIN MANHOLE (PIPE SIZE: 8", 10", 12", 15", 18", 21", 24")	FH	$ 1,500.00	0.0	$ -

Project Name:	CNO H&H DRAINAGE STUDY - LAKEVIEW N&S				Concept 12
DPW Proj. No.:	DPW724				
DPW PW No.:	D3791500				
Std. Spec.	DESCRIPTION OF ITEM	Unit	Unit Price	Qty.	Total Cost
C702(52)(L)	NO. 3 STANDARD DRAIN MANHOLE (PIPE SIZE: 36")	FH	$ 2,000.00	0.0	$ -
C702(52)(M)	SPECIAL DRAINAGE MANHOLE	EA	$ 17,500.00	0.0	$ -
C701(74)	REMOVAL AND DISPOSAL OF EXISTING DRAINLINES [SEPARATE TRENCH]	LF	$ 50.00	0.0	$ -
C702(53)(T)	STANDARD SINGLE MOUNTABLE CATCH BASIN	EA	$ 5,000.00	0.0	$ -
C701(53)(E)	REINFORCED CONCRETE PIPE (12" RCP)	LF	$ 340.00	185.0	$ 62,900.00
C701(53)(G)	REINFORCED CONCRETE PIPE (18" RCP)	LF	$ 290.50	0.0	$ -
C701(53)(I)	REINFORCED CONCRETE PIPE (24" RCP)	LF	$ 313.50	0.0	$ -
C701(53)(K)	REINFORCED CONCRETE PIPE (30")	LF	$ 375.00	0.0	$ -
C701(53)(M)	REINFORCED CONCRETE PIPE (36")	LF	$ 350.00	0.0	$ -
C701(53)(N)	REINFORCED CONCRETE PIPE (42")	LF	$ 600.00	0.0	$ -
C701(53)(O)	REINFORCED CONCRETE PIPE (48")	LF	$ 700.00	0.0	$ -
C701(53)(P)	REINFORCED CONCRETE PIPE (54")	LF	$ 750.00	0.0	$ -
	5'x5.5' BOX CULVERT	LF	$ 1,700.00	0.0	$ -
	42" BOX CULVERT	LF	$ 650.00	0.0	$ -
	36" BOX CULVERT	LF	$ 425.00	0.0	$ -
	6.5'x6' BOX CULVERT	LF	$ 2,400.00	0.0	$ -
	VAULT CONNECTION STRUCTURE	EA	$ 22,500.00	0.0	$ -
	FLOW CONTROL STRUCTURE	EA	$ 22,500.00	1.0	$ 22,500.00
	FLOW SPLITTER STRUCTURE	EA	$ 30,000.00	1.0	$ 30,000.00
	BRIDGE CROSSING - 003	SY	$ 3,825.00	0.0	$ -
	MODULAR TANK SYSTEM - 009	CY	$ 227.71	0.0	$ -
	MODULAR TANK SYSTEM - 001	CY	$ 331.84	0.0	$ -
	MODULAR TANK SYSTEM - 002	CY	$ 274.18	0.0	$ -
	STORMWATER PARK - 003	CY	$ 56.99	0.0	$ -
	STORMWATER PARK - 004	CY	$ 57.83	0.0	$ -
	STORMWATER PARK - 005	CY	$ 71.43	0.0	$ -
	MODULAR TANK SYSTEM - 006A	CY	$ 402.33	0.0	$ -
	MODULAR TANK SYSTEM - 006B	CY	$ 457.75	0.0	$ -
	SUNKEN GARDEN - 007A	CY	$ 210.67	0.0	$ -
	PERMEABLE PAVEMENT - 007B	SY	$ 200.00	0.0	$ -
	BIOSWALE - 008A	CY	$ 271.16	0.0	$ -
	MODULAR TANK SYSTEM - 008B	CY	$ 246.14	0.0	$ -
	GREEN ROOF -008C	CY	$ 1,261.94	0.0	$ -
	STORMWATER PARK - 011	CY	$ 61.66	0.0	$ -
	STORMWATER PARK - 012	CY	$ 59.57	31000.0	$ 1,846,670.00
	BOX CULVERT EXCAVATION - 010	CY	$ 45.00	0.0	$ -
	CLOSED BOX CULVERT (9'x25') - 010	LF	$ 10,000.00	0.0	$ -
	OPEN BOX CULVERT CANAL BLVD - 010	SY	$ 240.00	0.0	$ -
			$ -	0.0	$ -
CS-1(A)	15" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(B)	24" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 12,500.00	0.0	$ -
CS-1(C)	30" RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 17,250.00	0.0	$ -
CS-1(E)	XL RCP HINGED WALL CONNECTION TO R.C. BOX CANAL	EA	$ 25,000.00	0.0	$ -
TOTAL ESTIMATED COSTS					$ 1,989,452.30
30%	Low Contingency				$ 1,392,616.61
50%	High Contingency				$ 2,984,178.45

Appendix H. Field Reconnaissance

Delivered electronically

Appendix I. Electronic Appendix

I.1 Model

This appendix describes the .zip archives included with this report containing electronic files associated with this analysis. These files include the full suite of exported flood model results for the existing conditions, described in Section 3, and concept scenarios, described in Section 4.5.

The flood model results were exported as shapefiles and are viewable within ESRI GIS software, such as ArcMap, or free GIS software such as QGIS (available here: https://www.qgis.org/en/site/forusers/download.html). These are the same results extracted to develop the flood mapping figures in Appendix F, as well as the results in Section 3.4 and Section 5.2. In addition, GIS files used to develop map figures, such as those representing the observation points where model results were extracted, are included.

The following files and zipped folders are included:

- PC SWMM Models: Detailed models used for simulating stormwater management and flood scenarios. Models detailed in Table I-1 and AppI_ElectronicAppendixLogs.xlsx
- Post Processed Model Results: Processed results from the flood models, details of files found in Table I-2 and AppI_ElectronicAppendixLogs.xlsx

Table I-1. Model Log

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Version	Scenario Name	Return Period (years)	Event Duration (hours)	Approx Model Run Time (H:M)	Model updates
12	Various Models - See TM 2	10, 4/10/24, 9/4/23	36 24 24	4:00 - 6:30	Baseline model run (10-year event and 24-hour storm duration). Model updates included topography adjustment, 2D modelling approach for Lakeview area and major strom drainage system update based on Batture survey (see Sections 2.2.1 and 2.2.2). Pumps start up and shut off depth remained unchanged from the Ardura models. Pump curves for DPS-07 and DPS-12 were adjusted to reach 100% capacity (see Section 3.3). Version used for validation model runs with April 10, 2024 and September 4, 2023 rainfall event applied. All changes from the baseline model remained unchanged. Referenced in TM 2.
17	Various - See Model Log	1, 10, 25	36	10:00 - 15:00	Baseline model runs with 1) topography adjustment, 2) drainage system update based on Batture survey, 3) pump curves for DPS-07 and DPS-12 adjusted to reach 100% capacity, 4) JIRR/DPW/SWBNO projects included. Referenced in Final Report
18	Various - See Model Log	10	36	4:00 - 12:00	Baseline model runs with 1) topography adjustment, 2) drainage system update based on Batture survey, 3) free outfalls at DPS-07 and DSP-12 pumps, 4) JIRR/DPW/SWBNO projects included. Referenced in sensitivty in Final Report

ID #	Model File Name	Model Description	Model Version	Rainfall Return (Yr)	Duration (Hr)	Rainfall Total	Concept	DPS-07 & DPS-12 Operations	PCSWMM Model Files Package
NO_1Yr_2D_017	NO_1Yr_2D_017	Baseline Model with EC Pumps and JIRR Projects	17	1	36	4.65	BL	Existing	CNO_Baseline.pcz
NO_10Yr_2D_017	NO_10Yr_2D_017	Baseline Model with EC Pumps and JIRR Projects	17	10	36	8.3	BL	Existing	CNO_Baseline.pcz
NO_25Yr_2D_017	NO_25Yr_2D_017	Baseline Model with EC Pumps and JIRR Projects	17	25	36	10.5	BL	Existing	CNO_Baseline.pcz
NO_10Yr_2D_018	NO_10Yr_2D_018	Baseline Model with Free Outfall Pumps and JIRR Projects	18	10	36	8.3	BL	Free Outfall	CNO_Free_outfalls.pcz
NO_10Yr_017_C01	NO_10Yr_017_C01	Concepts 1 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	01	Existing	CNO_Concepts.pcz
NO_10Yr_017_C02	NO_10Yr_017_C02	Concepts 2 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	02	Existing	CNO_Concepts.pcz
NO_10Yr_017_C03A	NO_10Yr_017_C03A	Concepts 3A in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	03A	Existing	CNO_Concepts.pcz
NO_10Yr_017_C03B	NO_10Yr_017_C03B	Concepts 3B in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	03B	Existing	CNO_Concepts.pcz
NO_10Yr_017_C04	NO_10Yr_017_C04	Concepts 4 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	04	Existing	CNO_Concepts.pcz
NO_10Yr_017_C05	NO_10Yr_017_C05	Concepts 5 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	05	Existing	CNO_Concepts.pcz
NO_10Yr_017_C06	NO_10Yr_017_C06	Concepts 6 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	06	Existing	CNO_Concepts.pcz
NO_10Yr_017_C07	NO_10Yr_017_C07	Concepts 7 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	07	Existing	CNO_Concepts.pcz
NO_10Yr_017_C08	NO_10Yr_017_C08	Concepts 8 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	08	Existing	CNO_Concepts.pcz
NO_10Yr_017_C09	NO_10Yr_017_C09	Concepts 9 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	09	Existing	CNO_Concepts.pcz
NO_10Yr_017_C10	NO_10Yr_017_C10	Concepts 10.1 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	10	Existing	CNO_Concepts.pcz
NO_10Yr_017_C11	NO_10Yr_017_C11	Concepts 11 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	11	Existing	CNO_Concepts.pcz
NO_10Yr_017_C12	NO_10Yr_017_C12	Concepts 12 in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	12	Existing	CNO_Concepts.pcz
NO_1Yr_017_C13	NO_1Yr_017_C13	Combined Concepts in Baseline Model with EC Pump & JIRR Projects	17	1	36	4.65	13	Existing	CNO_Concepts.pcz
NO_10Yr_017_C13	NO_10Yr_017_C13	Combined Concepts in Baseline Model with EC Pump & JIRR Projects	17	10	36	8.3	13	Existing	CNO_Concepts.pcz
NO_25Yr_017_C13	NO_25Yr_017_C13	Combined Concepts in Baseline Model with EC Pump & JIRR Projects	17	25	36	10.5	13	Existing	CNO_Concepts.pcz
NO_10Yr_018_C13	NO_10Yr_018_C13	Combined Concepts in Baseline Model with Free Outfall Pumps & JIRR Projects	18	10	36	8.3	13	Free Outfall	CNO_Free_outfalls.pcz

Table I-2. GIS File Log

GIS Data Log	File	Atribute Details
1-Year, 24-Hour Existing Conditions Maximum Depth	Results_combined.shp	BL_1yr_D
10-Year, 24-Hour Existing Conditions Maximum Depth	Results_combined.shp	BL_10yr_D
10-Year, 24-Hour Free Outfall Scenario Maximum Depth	Results_combined.shp	FO_10yr_D
25-Year, 24-Hour Existing Conditions Maximum Depth	Results_combined.shp	BL_25yr_D
Concept 1 Maximum Depth	Results_combined.shp	C01_D
Concept 2 Maximum Depth	Results_combined.shp	C02_D
Concept 3A Maximum Depth	Results_combined.shp	C03A_D
Concept 3B Maximum Depth	Results_combined.shp	C03B_D
Concept 4 Maximum Depth	Results_combined.shp	C04_D
Concept 5 Maximum Depth	Results_combined.shp	C05_D
Concept 6 Maximum Depth	Results_combined.shp	C06_D
Concept 7 Maximum Depth	Results_combined.shp	C07_D
Concept 8 Maximum Depth	Results_combined.shp	C08_D
Concept 9 Maximum Depth	Results_combined.shp	C09_D
Concept 10 Maximum Depth	Results_combined.shp	C10_D
Concept 11 Maximum Depth	Results_combined.shp	C11_D
Concept 12 Maximum Depth	Results_combined.shp	C12_D
Concept 13 Maximum Depth (10-Year)	Results_combined.shp	C13_D
Concept 13 Maximum Depth (1-Year)	Results_combined.shp	C13_1yrD
Concept 13 Maximum Depth (25-Year)	Results_combined.shp	C13_25yrD
Concept 13 Maximum Depth (10-Year, Free Outfall)	Results_combined.shp	C13FO_D
Concept 1 Maximum Water Surface Elevation Difference	Results_combined.shp	C01_DIFF
Concept 2 Maximum Water Surface Elevation Difference	Results_combined.shp	C02_DIFF
Concept 3A Maximum Water Surface Elevation Difference	Results_combined.shp	C03A_DIFF
Concept 3B Maximum Water Surface Elevation Difference	Results_combined.shp	C03B_DIFF
Concept 4 Maximum Water Surface Elevation Difference	Results_combined.shp	C04_DIFF
Concept 5 Maximum Water Surface Elevation Difference	Results_combined.shp	C05_DIFF
Concept 6 Maximum Water Surface Elevation Difference	Results_combined.shp	C06_DIFF
Concept 7 Maximum Water Surface Elevation Difference	Results_combined.shp	C07_DIFF
Concept 8 Maximum Water Surface Elevation Difference	Results_combined.shp	C08_DIFF
Concept 9 Maximum Water Surface Elevation Difference	Results_combined.shp	C09_DIFF

GIS Data Log	File	Atribute Details
Concept 10 Maximum Water Surface Elevation Difference	Results_combined.shp	C10_DIFF
Concept 11 Maximum Water Surface Elevation Difference	Results_combined.shp	C11_DIFF
Concept 12 Maximum Water Surface Elevation Difference	Results_combined.shp	C12_DIFF
Concept 13 Maximum Water Surface Elevation Difference (10-Year)	Results_combined.shp	C13_10yDIFF
Concept 13 Maximum Water Surface Elevation Difference (1-Year)	Results_combined.shp	C13_1yDIFF
Concept 13 Maximum Water Surface Elevation Difference (25-Year)	Results_combined.shp	C13_25yDIFF
Concept 13 Maximum Water Surface Elevation Difference (10-Year, Free Outfalls)	Results_combined.shp	C13_FODIFF
Concept locations	BGSI_Location_Updated.shp	NA
Hot Spot Locations	hot_spots.shp	NA

I.2 Survey Data

Delivered electronically